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(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

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—AND—

GENERAL SCIENCE.

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(FORTY-SIXTH YEAR.)

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[OFFICIAL NOTICE.]

Where to Find the Western Gas Association's Exhibit, and the Custodian Thereof, at the World's Fair.

To the Fraternity: The exhibit of the Western Gas Association, at the World's Fair, St. Louis, is located in Section 33A, Liberal Arts Building, where Mr. Fred. R. Persons, who is in charge of the same, will always be on hand to receive visitors and to explain anything that requires explaining.

[NOTICE.]

Twelfth Annual Meeting, Pacific Coast Gas Association.

SAN FRANCISCO, CAL., June 6th, 1904.

To the Members of the Pacific Coast Gas Association: The Twelfth Annual Meeting of the Pacific Coast Gas Association will be held in the city of San Francisco, Tuesday and Wednesday, July 18th and 19th, 1904, and will be called to order at 10 A.M., Tuesday, by Mr. W. A. Aldrich, President. Place of meeting, Assembly Hall, Mechanics' Library, Post street, between Montgomery and Kearny.

The meeting of the Directors will be held Monday, July 17th, 1904, at 8 P.M., at the office of the Secretary, 427 Rialto Building, corner New Montgomery and Mission streets.

The following papers will be read:

President's Address, by Mr. W. A. Aldrich.

"Benefits of Consolidation," by Mr. John Martin.

"Some Practical Observations on the Flow of Gases in Pipes," by Mr. L. P. Lowe.

"Auld Lang Syne," by Mr. T. R. Parker.

"Notes Regarding California Petroleum," by Mr. P. W. Prutzman.

"Pressure Points," by Mr. E. C. Jones.

"From a Consumer's Standpoint," by Mr. John A. Britton.

"Effective Steam Plants for Gas Manufacture," by Mr. C. H. Pennoyer.

"American vs. English Gas Cooking Stoves," by Messrs. A. S. Main, Glasgow, Scotland; C. S. Barbour, London, England; H. Trenkamp, Cleveland, O.

"Wrinkles," edited by Mr. R. P. Valentine.

"Experiences," edited by Mr. Geo. S. Colquhoun.

"Novelty Department," edited by Mr. Geo. H. Hollidge.

"Question Box."

The annual banquet will be held Wednesday, July 19th, at 7 P.M.

The annual outing, for members, their families and friends, to Alum Rock, Santa Clara county, is set for Thursday, July 20th, particulars of which will be announced at meeting.

Arrangements have been made for a lecture on "Radium," to be given Tuesday evening, July 18th, by Prof. Edward Booth, of the University of California, to which members and their families will be admitted.

JOHN A. BRITTON, Secretary.

LIBRARY OF CONGRESS 5 1904 SMITHSONIAN DEPOSIT

BRIEFLY TOLD.

OBITUARY NOTE—MR. ALPHEUS B. SLATER.—With exceeding regret we chronicle the death of Mr. Alpheus Brayton Slater, whose demise occurred at his home in Providence, R. I., the night of Sunday, June 26th, after a short, sharp struggle with the fell ailment, pleuro pneumonia. Although not actively engaged in business for the past four years or so, Mr. Slater's relation to the gas history of America will always be that of one who did much for the development and elevation of his calling, and his death removes another of that fast-dwindling band whose belief in their business was superior to doubt as to its continued success. Deceased was born in Warwick, R. I., November 26, 1832, and received his preparatory education in the public schools of Newburyport, Mass., and East Killingly, Conn., and the finishing touches thereto were acquired at the Smithville Seminary, at North Scituate and the Conference Seminary, East Greenwich. In 1853 he entered the service of the Providence (R. I.) Gas Company, and in 1858 was appointed its Chief Clerk. In March, 1869, he was elected Assistant Treasurer, and in February, 1870, he was elected a Director of the Company, and formally appointed to the dual position of Treasurer and Secretary, which posts carried with them the duties of General Manager. These places of trust and responsibility he carried on with credit to himself and with profit to his employers, until his retirement therefrom some few years ago. To his tact, energy and forcefulness the greater part of the commanding position now held by the Providence Gas Company is due, for while he was in its employ his best thought and deed (and they were never wanting) were unsparingly and judiciously used for its advancement.

Mr. Slater was prominent for well over a quarter century in the furthering of the best interests of the industry through Association work. He was one of the founders of the New England Association of Gas Engineers, and was its fifth President (1882 to 1884); a founder of the Guild of Gas Managers, and always a prominent supporter thereof; an active member of the American Gas Light Association (Oct., 1873), its 10th President (1889), and named to honorary membership therein, Oct., 1902; and was elected an honorary member of the Western Gas Association at its meeting, May, 1886. He was also one of the earliest non-resident members of the Society of Gas Lighting. He was a fluent writer, and the records of several of the named societies bear witness to the fact that, through written presentations made by him, his alert, well-balanced mind was always at the command of his fellow-workers, whose main thought was for the general good of their industry. In fact, it may be said of him that he curried favor from none, but was always ready to contend for the *right*. And in the early eighties it required a man of courage in the gas trade to speak as Mr. Slater spoke. The compiler of this record knew personally and well the subject of his story, and it is his province to say that A. B. Slater was in every sense a man. The funeral services were held at his home in Providence, the afternoon of the 29th inst., and those who paid him the final honors included goodly numbers from the New England Association of Gas Engineers, the Guild of Gas Managers, and the Society of Gas Lighting. The surviving next of kin are his children, Lora B., Alpheus B., and Howard C. Slater. For many of the facts in connection with this history we are indebted to Mr. Alpheus B. Slater, Jr.

NOTES——

IT is with much satisfaction that we chronicle the reappointment, by Governor Bates of Massachusetts, of Mr. Forrest E. Barker as Chairman of the State Board of Gas and Electric Light Commissioners.

MR. W. E. STEINWEDELL, ex-Editor of the Wrinkle Department of the Western Gas Association, desires us to say that the Association has on hand a few copies of "All American Gas Wrinkles" that were considered by the different Associations from 1891 to 1900. This compilation was made by Mr. Steinwedell, at the direction of the Western Gas Association, and it is complete. The cost of the volume is $1, and it can be obtained by communicating with Mr. Steinwedell at his address, "The Gas Machinery Company," Cleveland, O.

ONE of the events at the Gas Congress meeting in St. Louis last month, and which will not be chronicled in the official proceedings thereof, but which nevertheless was of the most interesting order, was the presentation to Mr. Fred. H. Shelton, by the Managers of the gas companies that he controls, of a magnificent silver loving cup. Mr. Thomas D. Miller, of New Orleans, made the presentation, and his speech indicated "What Shelton's men think of him." The other Managers present were Messrs. L. R. Dutton, R. H. Dutton, J. D. Shattuck, Thos. O. Horton, G. W. Beck and David Buck.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.]

TWENTY-SEVENTH ANNUAL MEETING, WESTERN GAS ASSOCIATION.

HELD IN THE HALL OF CONGRESS, ADMINISTRATION BUILDING, LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., JUNE 14TH, 1904.

MORNING SESSION.

The meeting was called to order by the President, Mr. F. H. Shelton, at 10:40 A.M., of June 14th. Secretary Dunbar announced the regular order of business, and the President recited the several items, action on which was taken as follows: The roll call was deferred, the reading of the minutes of the last meeting was dispensed with, and the report of the committee regarding the election of new members was also deferred.

The President called for the

REPORT OF THE BOARD OF DIRECTORS,

which Secretary Dunbar read as follows:

The annual meeting of the Board of Directors of the Western Gas Association was held in the Hotel Jefferson, at 2 P.M., Monday, June 13th, Mr. F. H. Shelton presiding. The following members were present: F. H. Shelton, O. O. Thwing, Paul Doty, John D. McIlhenny, Wm. McDonald, D. R. Warmington, Geo. S. Clarke and Thos. D. Miller.

On motion of Mr. Warmington the following papers were accepted for presentation to the Association:

"Low Candle Power Gas," by Capt. Wm. Henry White.
"Coal Projectors," by Mr. F. H. Shelton.
"Wrinkle Department," edited by Mr. Wm. E. Steinwedell.

The following committees were appointed:

Auditing—Messrs. F. H. Shelton, George S. Clarke and John D. McIlhenny.

On Memorials—Mr. Paul Doty.

On Membership—Messrs. Wm. McDonald, Thos. D. Miller, D. R. Warmington.

The action of the President and Secretary was confirmed in selecting distinguishing badges to be worn as follows: Honorary members, white enamel letters; President and Past-Presidents, blue enamel letters; Secretary, green enamel letters; Membership, as at present, red enamel letters.

The Secretary was authorized to exchange Honorary and Past-President's badges for those they now have.

On motion of Mr. George S. Clarke, the Board extended a vote of thanks to Mr. O. O. Thwing, appreciative of his labors in editing the 4th volume of Proceedings, for the years 1898 to 1902, inclusive, recently published. On motion of Mr. Dunbar, the officers of the Association were directed to acknowledge the thanks of the Western Gas Association to gas companies contributing financial aid in meeting the expense of the gas exhibit at the Exposition.

It was ordered that each three months the Secretary send to members a list of volumes contained in the Thompson Memorial Library, calling their attention to the privileges afforded, and soliciting additional contributions.

On motion of Mr. Doty, a unanimous vote of thanks was extended to Mr. Shelton for his efforts and energies in inaugurating and maintaining the gas exhibit in the Liberal Arts Building.

Mr. Thwing moved the appointing of a committee to draft suitable resolutions expressive of the Association's appreciation of Mr. Shelton's labors and success in having successfully projected the exhibit of the Western Gas Association.

REPORTS OF SECRETARY AND TREASURER.

As Treasurer, Mr. Dunbar submitted his report, showing that the receipts for the year to May 1, 1904, were $2,932.45, that the expenditures had been $1,936.35, and that the cash balance was $996.10. As Secretary, Mr. Dunbar reported as follows:

Membership, May 1, 1903		377
Admitted during 26th Annual Meeting	38	
Reinstated during year	2	
		40
		419
Died during year	3	
Resigned	9	
Dropped for non-payment of dues	6	
		16
Membership, May 1, 1904		403

Badges on hand May 1, 1903	16
Sold during year	10
On hand May 1, 1904	6

On motion, the Directors' meeting was declared adjourned.

On motion, the report was received, adopted and placed on file.

The President—A subject which it was decided yesterday to put to a vote of the members is as to whether it would be better to have a single session and dispose of our work without adjourning until we adjourn this afternoon, or whether we shall reconvene after the lunch hour. There are expressions of opinion favoring both plans, and it seems to be the more practical plan to decide by popular vote as to which will be preferable. If we stay in continuous session it will probably be 3 o'clock before we get through—perhaps half past. We may get pretty hungry by that time, and the attendance is apt to thin out towards the rear end of such sessions in diametrical proportion to our augmenting appetites, as I have found by experience. If we adjourn at 12:30 or 1 and take an hour for luncheon, which we can get on the grounds, and reconvene promptly, say at 2 o'clock, we can then take 2½ to 3 hours, adjourning between 4 and 5, with probably a good degree of comfort. Both plans have been suggested, and the Chair proposes to leave to a vote of the floor as to which plan shall be adopted after conference on the suggestion.

Mr. Somerville moved a recess at 12:30 for an hour. (Seconded.)

The President—Are there any who desire to stay in continuous session from now until 3 P.M.

Mr. Forstall—If that resolution is passed, I suppose it is understood that every man here pledges himself to come back.

The President—I think the rider to the resolution is the best part of it; it should be lived up to. We have compressed our meeting into one day this year because of the local condition (the Gas Congress), so I think it is up to us to be good and pay attention to business to-day, enjoying ourselves during the balance of the week.

Mr. Norris—There must be a good many who have made arrangements to spend the afternoon otherwise than here, so there must be a good many who can not do as Mr. Forstall says; but I hope everyone will try to come to the afternoon session if this motion be passed. If I understand it, this motion is in favor of two sessions, those voting aye vote in favor of two sessions.

The President—As the Chair understands, Mr. Somerville moves that we adjourn about 12:30 for an hour's recess. I should suggest that we reconvene at 2 o'clock sharp. It will take over an hour to have luncheon and get back to the hall. The Chair in presenting the motion does it on the basis of adjourning at about 12:30, reconvening at 2 P.M. for the second session, and continuing this afternoon as far as our business session is concerned.

A vote was taken upon Mr. Somerville's motion, which was declared carried.

Next Place of Meeting.

The President—Another matter that may be disposed of at the moment and save a little time is the place of the next meeting. It is customary to appoint a committee on place of next meeting, who duly consider the matter and report later in the day. The Chair is entirely willing to conform to the custom if desired, but I have happened to run across quite a sentiment for going to Chicago next year. At least 8 or 10 have spoken of it. It is several years since we have been in Chicago, and I think there is quite a sentiment for meeting in the central portion of the country this ensuing year, as we have been a long distance, to Chattanooga and New Orleans, in the comparatively recent past; and as I have found no other suggestion as to any other place than Chicago, and a good, strong sentiment in favor of that place, it seems to me it may be disposed of right now without referring the matter to a committee and waiting for them to get hold of the members, ascertain public sentiment and report it. Understand, the Chair is perfectly willing to appoint a committee and have it report, if it is your pleasure; but if there is any general sentiment in favor of the suggested place, I think we may act on that now without the appointment of a committee.

On motion of Mr. J. B. Howard (seconded by several) after the vote was taken the President announced that Chicago had been unanimously selected as the next meeting place.

The President having called Mr. O. O. Thwing to the Chair, read the following

INAUGURAL ADDRESS.

The preponderance of custom in presidential addresses is to describe in general terms the prosperity of our business, praise onrselves in several fashions, throw out a lot of maxims as to increasing the use of gas plead for the increase of gas engines, advise the members to work diligently, and otherwise consume about 20 pages in platitudes, reviewing and generalities that usually are well understood and accepted already.

I propose to vary this by skipping the usual felicitations, dwelling on but few technical matters and by discussing and even criticising some association matters. Criticism usually provokes discussion and discussion usually leads to some improvements, and that is what I hope for. If you ask by what right I set up to preach a little, I say that the very office of president carries with it the obligation to give more than usual thought to internal matters and a duty to point out where improvement seems possible.

Obituaries.—The point I shall make first, because of thus the more honoring our past members, is the belief that the average association does not in its yearly gatherings show sufficient respect and appreciation to the memory of those who may have died during the year. The president in his address usually says "Death has again thinned our ranks," A. B. C. (as the case may be) having died during the year. Now and then some remarks are made. In some cases a committee is named to send resolutions to the family. Often but three or four minutes only of our time actually are devoted to the memories of the dead. I think this scant procedure is a shame. We come here year after year, shake the hand of good fellowship, give mutually of our knowledge, argue in friendly controversy, chaff in the corridors and join in the amusements; the next year the chair is empty; poor Bill Smith is gone—who is the next superintendent? "The King is dead; long live the King!" Only a half dozen intimates seriously realize the death; many do not know it; but few realize the work and the lesson that remain from the life of the one who has gone. I think it not enough. If I work for this Association, write papers for it, help to build it up, and, whether wisely or unwisely, yet earnestly strive to advance its interests, when I go, I want more than two lines in the presidential address, or a committee hurriedly reading an obituary, so as not to miss the excursion. Seriously speaking, I think we ought to make more of a feature of bringing out at the first morning session who and what the men were, who, in the preceding year have answered a greater roll call than that of any earthly association, and whose face and hand shake are gone forever. I recommend that it be made the fixed duty of the Secretary, upon the occasion of every death, to assign to some member well knowing the deceased, the melancholy duty of preparing a biographical sketch of his professional career and Association work; that this be formally read; that during this period of our session, running in and out of the hall be absolutely stopped, by sergeants at arms or otherwise, at the doors, and that a resolution of sympathy and copy of the proceedings of this Association always be sent by the secretary to the family. These things are very grateful to those at home. Whether high in our ranks or humble, at home the one who has gone usually was their all, and his recognition on some such lines by his business associates is something dear to the wife and children, and one that is long treasured. In the very few instances where such action should be either omitted or amplified, our directors can act. Let us cross bridges when we get to them, and hereafter those members listening to these words to-day, and who may pass away before May, 1905, may be more greatly revered than in the past. Can we not inaugurate a practice of greater evidenced respect?

Association Work.—The chief purpose of an association is that of gaining and exchanging knowledge and especially on so-called "practical" lines. Many ingenious schemes have been devised to that end by various associations, such as an advertising department, new business department, question box, progress department, etc., most of them following the general lead of the Wrinkle Department, first started by this Association. But in addition to procuring knowledge, members often want to procure *people and machinery*, and I have to propose the creation of a simple plan to that end, that to me seems entirely practical, as an aid to one's getting, when wanted, brains, brawn or pig iron, as well as the technical data we now get. That is, let the secretary maintain a record of all duly reported apparatus or machinery that any members may have for sale. outgrown, etc. Any member wanting to know what is available for sale or exchange can write the secretary and get a copy of what is listed. A fee of say 50 cents or some suitable sum should be paid for postage, typewriting, stationery and secretary's work that is extra. Would this not quickly develop into a clearing house of information as to pipe, meters, pumps, boilers, exhausters, and portable gas works apparatus and machinery that could be picked up cheap, by and to the advantage of the small companies especially. The correspondence and trades would, of course, be carried on direct, so that the association would fill only an introductory capacity, and have no responsibility whatever beyond that. A clear-

ing house for people, superintendents, office men, foremen, etc., could be handled on precisely the same lines. A man dissatisfied or anxious to advance could file his qualifications and facts. An inquirer would have forwarded him by the secretary memorandum of all on file in any class designated, and then they would correspond direct.

I predict that if tried, the plan would work well and also be copied by other associations.

Gas Association Consolidation.—And now, gentlemen, let us wrestle with a larger subject; that of the growing question of too many associations—a subject that nearly everyone concedes, as far as I can observe, informally, and yet that no one seems willing to come out upon officially. As I have no individual association ambitions, am relinquishing my unsought present office to return to the ranks, have neither axes to grind, trade interest to protect, but quite the contrary, I imagine I can make the following remarks with the least amount of the usual resulting criticism for having "spoken out in meeting."

There are too many associations in this country. Or rather, each association in itself is legitimate, earnest in its work and theoretically all right, but practically there is too much waste of energy and of money *spent in parallel*, competition for membership and sometimes resultant and unnecessary jealousies. For instance, take the Ohio Association. It is avowedly aiming to become a third great national association, for which I can locate no demand whatever. Organized, looked upon, accepted and praised for years as a strong State Association, to improve and protect the interests of Ohio gas companies, it is raising heaven and earth, and the quantity of mail bags required in the postal service, to get a national position, by soliciting memberships from Portland, Me., to Portland, Ore., and all the towns between. It is arousing much criticism in so doing, and for what purpose? An ordinary gas man, say in Wisconsin or Virginia, can go to but a couple of meetings a year, and is not going to the Ohio in addition to his own State meeting and to the big association meetings, which have the first choice. And is a large numerical paper membership desirable to people who do not come to the meetings of the association? With the big campaigning of this spring and 188 new memberships secured by the Ohio, there was but a small percentage of either new or old members present; many of the new were already members of other associations, and only doubled up on dues, and with a total for the meeting of 430 or so on the rolls, they could not get more than 68 railway certificates. I tell you, gentlemen, it is a tremendous lot of misspent energy. Do not misconstrue my position. I have not an atom of antagonism to the Ohio, excepting this recent policy, and what I am saying and describing is to lead up to not what the Ohio happens to be doing; but what all our associations, in my judgment, *ought* to do. I am a member of the Ohio; have written papers for it, esteem it, have worked for it and will work for it. I like and admire personally those who are shaping its policy and work; the recent voluminous Ohio "Question Box" is in the main great. But why should not all this magnificent energy to create a new large association be expended through, and in conjunction with, existing other assaciations, instead of separately. If it is because of jealousies or pride, or local reasons, such is precisely my point: *It is about time to get together.*

The principle of consolidation is so universally recognized, that any special comment in its behalf is almost unnecessary. We recognize its desirability by consolidating in our own business in every way; departments are consolidated to decrease expense and improve results; plants are consolidated into single stations; companies are consolidated for the same purpose. The tendency is marked and recognized in almost all lines of business and the results are almost invariably beneficial, both directly and indirectly.

At the present time there are nine associations of gas men in this country, with about 2,600 individual, separate memberships. These nine associations involve nine separate annual meetings, nine sets of officers and other necessary expense, nine editions of proceedings, with their expense of publication, nine secretaries, salaries, etc., etc. In addition to this expense of money, there is a great expense of energy and time and labor from the fact of each association often thrashing out the same thing on its own account that is at the same time being done—or has already been done—by some other association, and by various members writing upon the same subject, and often writing virtually the same thing. The various associations also interfere with one another to some extent by the fact of the yearly meeting necessarily coming at the same time in several cases. For instance, it is impossible for anyone desirous of attending the New England meeting to likewise attend some meetings in the West, all of which occur in February, and it is practically impossible for anyone to attend all of the meetings in any event, owing to their numbers and scattered locations. Our supply men members especially feel this. A very important question further is the fact that different standards are proposed and adopted by the various associations, making complications in our technical work.

It seems to me self-evident that more or less of a consolidation or uniting of our associations would be to our benefit. It should be possible. The men who direct and constitute them are practical, experienced, broad minded, and as a rule thoroughly desirous of advancing the interests of the gas business, aside from personal ambitions or prejudices. Nor ought it in theory to be tremendously difficult to determine a plan for union. If our associations were corporations commercially competing one with another, and if we had assets with valuations to be agreed upon, it might be difficult to adjust ideas as to relative values in any plan of union, but being purely voluntary associations for advancing our business in the various sections of the country, with no commercial interests to conflict, the interests of sentiment and geographical location ought to be fairly easy to adjust if any effort is made in sincerity to that end.

I recognize that some of the associations are purely State associations, whose organization is desirable and necessary to protect local interests in matters of legislation, taxation, etc., where a united local front is often of importance. I recognize also that the various associations today are in full and separate swing with their own organizations, officers, committee work, etc., that could not all at once be readily altered. I believe, however, that it is perfectly possible to determine a plan of union by which certain State organizations, where desirable, could continue at nominal expense as local chapters for local, commercial, political and social, but not technical purposes, and a plan whereby a combination might become effective not within this or next year, but after perhaps 3 years, within which time the present officers could go their allotted courses and complete their work, and after which time the joint body could elect successors on common account. I believe a plan could be evolved, moreover, by which with an annual meeting alternating every other year, east and west, or with two meetings yearly, east and west alternately, the two great sections of this country could be easily geographically recognized, and a plan that would result in a common national organization, comprising a membership of 1,500 or 2,000 individuals, instead of a maximum present membership of 700 odd, with the yearly results of all of our gas associations energy concentrated into one channel and to our great benefit. If membership in a great general organization carried with it dues of $10 a year (no more than many gas men pay and often less), there would be an income far in excess of any so far enjoyed that would permit of the doing of association work by the secretary (who would do nothing else), and even an assistant, and of far more work of investigation, recording, etc., for the benefit of the members than has yet been possible. Local State "chapters," wholly for State purposes, could be maintained by those so desirous at an expense of but a dollar or two a year per member, without complication to the general organization. The result of this combination would be uniform standards, for instance, proposed, recommended and adopted on behalf of gas interests at large, from the Atlantic to the Pacific. It would mean a gas organization, national in reality and far more powerful than ever before, or any now existing, with a solid and united front, that would be of great value in matters of legislation, franchises taxation and representation of the industry from time to time as occasion arose. Such a united organization of the gas interests of America would then be abreast of such organizations in many other engineering lines, a position lacking heretofore, that would advance our standing in the eyes of all observers.

I recognize that some years ago a plan of federation was proposed, not at that time favorably considered. That plan, however, was much short in my opinion of what it should be. It was merely a federation of the associations by each association as a whole, not as individuals. Each association counted but one vote, and a small State organization of 50 or 60 members, therefore, had as much influence as the largest, which was illogical. Its operation virtually contemplated only the publication of proceedings on joint account (which aroused the gas journals), and of several committees upon investigation, standards, etc., on joint account. It did not contemplate the union of the aggregate members of the various associations into a common organization man for man, and as individuals, with the financial revenues that should result, and many of the benefits that I have above referred to, and that I believe are possible.

The subject is a weighty one that, of course, cannot be acted upon either favorably or otherwise without most careful consideration and investigation of ways and means and probable results. But with all of the theoretical arguments in its favor, and many practical points of

benefit that are obvious and admitted, and comparatively little to be said in the negative, it does seem to me that the time has come for an earnest effort to be made for the union, not of any particular two associations, but of the majority of all of our associations, into the solid organization proposed, more powerful and more capable than ever in the work of advancing the interests of the American gas industry, and an organization that should add to the prestige and successful record of development enjoyed by the gas profession of this country.

I believe that this Association would be found ready to appoint a committee at any time, prepared to confer with committees that I hope will be appointed by other associations, to act on this subject.

Mark my words, gentlemen, we will consolidate in some shape before we get through, not because we are not doing very well now, but because consolidated we will do very much better.

Gas Congress.—I commend to your interest the Congress of our United States Associations that will convene in this city to-morrow. And I take some pleasure in pointing out that it is the direct result of a communication that, as your president, and acting for this Association, I made to the council of the American Association in October last in Detroit proposing that the American and Western, the two major Associations of the country, unite to hold such a Congress, inviting the other associations to participate. While the American finally elected to do it but in his own name, your Association has, nevertheless, aimed to do everything possible to enhance the success of such. It has advertised it twice extensively, twice issued announcements on its own Association meeting invitations, to remind gas men; has condensed its own meeting into one day; has advanced its regular date of meeting a month to insure the Congress a good attendance; has assisted financially and in the local arrangements; and is contributing three of the five or more papers that will be read at the Congress.

I am sure you join me in the earnest hope that this first common gathering of the United States associations may be a great success, that it may lead to a greater appreciation of other associations, each by the other, and be perhaps a first step in a future union on some lines of all.

Ceasing now my "house cleaning" let us dwell briefly on one or two technical points.

Improvements.—That which impresses me most is how the gas business keeps forging ahead, how volumes of output roll up, how the inventive chap keeps busy. Works after works report 15, 20 and 30 per per cent. annual gain and larger works, too. Where does it all come from? Advertising, education, good service, liberal policy, low prices, convenience of gas; each of these are some of the answers. And as to equipment: Old-fashioned horizontals are followed by inclines, and before they are cold come rotary, whirligig coal projectors of exceeding attractiveness, and even while they are abornin' vertical retorts are being tried again in several countries with high promise of success, perhaps in the near future to do away with machinery entirely. Verily, the last chapter is rarely written.

Mechanical Handling.—Concerning our works there are but two questions I wish to dwell on. The first is a greater use of mechanical conveyors or machinery to save coal and coke handling in the average works, and I mean small works.

For instance, a plant running 4 to 6 benches of 6's can put in a conveyor to take coal from the spouts of a coal bin 100 feet long at the ground level, lift it up 25 feet, crush it to uniform size and carry it over to the retort house, say, 100 feet, discharging it into convenient sma'l bins in the roof for about $4,000. Such a plant will run over in an hour enough coal for all day into bins, whence it can be drawn as needed by spouts in front of each row of retorts. The interest on this investment at 5 per cent. is $200. Will not $200 of labor a year be saved by such a rig—and even if not, is not the convenience, the capacity for the future and the improvement of men's condition worth that much? On coke (and for oxide also) a light, simple rig comprising dumping buckets, carried on overhead rails of 6-inch I-beams leading out to the coke sheds, is immeasurably superior to the usual barrows or wagons on rough floor or rails, costs but little, is well worth while, and can be amplified to any degree desired according to the size of the works.

In the last 2 years a good deal of study of this handling of coal and coke has convinced me that many works, and the average works are under-equipped, are working crudely and laboriously compared with what might be, and could save money and greatly improve their convenience, economy and quickness of working by adding small conveying rigs. On the other side of the ocean where they have been in business longer than we have they have better learned this lesson and have many more mechanical rigs.

Pleasing Architecture.—My other point is a plea for better architecture in gas plants. There are too many buildings which are put up by mere country masons or constructors (unguided by the superintendent) who have not the remotest idea or object beyond a tight roof and sound wall. As a result the race of plain, homely, white mortar, plastered, usually corbelled brick is perpetuated, and the gas factories generally are as homely as ever. A little intelligent supervision would greatly improve this. Red mortar instead of white, dignified lines, some curves between pilasters, instead of square panels, an ornamental key over the window and door arches, doors and window, located symmetrically, instead of hit or miss; such things scarcely add to the cost and make a vastly better looking result. I recognize that in piecing out an old works, conditions often do not permit or warrant this. Yet in new detached buildings, and certainly in new plants (and there are a score a year constructed), more attention should be paid to *looks*. It improves the labor tone, you can brag of it to your neighbors, and get 5 or 10 per cent. better price on *looks* when you combine or sell out to a syndicate.

Progress.—In closing, let me add only these words: The gas business that was to be put out of business by the electric people, that was also declared made extinct by the acetylene chaps, and that has been threatened also by various other "would be's," is yet a mighty lively proposition, and a pretty good business to pin to. It has solved many troubles arising in its own operation, it has gone through troubles arising from outside, it has given vast comfort and convenience to the public outside. It has its problems yet to solve. The chap who perfects the gas heater for cellar furnace work, who perfects vertical retorts, who invents a gas turbine engine, who evolves such an equitable labor scheme as will solve the strike question, who gets us upon a uniform and fair franchise and tax basis, who gets gas from the air by successful nitrogen elimination process at a fraction of our present costs, each of these chaps can smoke perfectos and leave fame and dollars to posterity.

And as we saw wood while solving these problems, each with the best intelligence that has been given us, remember what the old warhorses in the business have learned three maxims of success, I find, and which I commend to those coming into the business: "Venture to try new things; work; play fair."

On motion, the address was ordered referred to a committee of three for consideration. Chairman Thwing named as such committee Messrs. Paul Doty, H. L. Doherty and Rollin Norris.

AN ANNOUNCEMENT FROM THE COMMITTEE OF ARRANGEMENTS.

Mr. Cowdery—Gentlemen, your Committee of Arrangements regret that they are unable to have located except in one hotel in this city, so as to make it most convenient for you, but you all probably understand how impossible it was to do that. Your committee did the best under the circumstances that it was able to do. The committee have provided an entertainment for the visiting members a little beyond the ordinary, because this was considered an occasion beyond the ordinary. Banquet tickets are sold at $5 each, as is the custom, but anyone purchasing a banquet ticket is entitled to the privileges of the balance of the entertainment. Tickets are furnished with the banquet tickets which will entitle you to the entertainment upon the "Pike" to-morrow evening. The members will have to pay their own admission to the grounds. The presenting of coupons encountered so many difficulties that the Committee were unable to carry out that portion. The members will assemble on the St. Louis Plaza, opposite the Louisiana Column, promptly at 8 o'clock to-morrow evening, to take the boats for the ride around the Lagoon, where they will have the pleasure of seeing the cascades in all their beauty, and the buildings illuminated. This trip takes something like half an hour. Upon finishing that trip, the members will proceed to the "Pike," and enter at the end here promptly at 9 o'clock. From there they will go to the North Pole promptly at 10 o'clock, and further, to the Paris Theater, at 11 o'clock. It is supposed that the entertainment will be through between half past 11 and 12 o'clock. The tickets only entitle the members to enter the various places at the hour named. Of course, those wishing to omit any one of these places would simply be on time at the next place. You will notice carefully that the tickets for the "Pike" entertainment are for gentlemen only, and the gentlemen will please furnish such other entertainment for their ladies during that evening as they can. Should a stray lady accompany a member upon the lagoon ride, if she has a ticket, there may be no particular objection, but you will be obliged to dispose of the lady immediately afterwards. The members buying banquet tickets or attending here will please register with the clerks, in the committee room to the north, the names of the ladies accompanying them. Each member is entitled to tickets for the immediate members of his family attending with him, not exceeding two, and

extra tickets can be bought for the ladies at $3 each. In registering these names, the tickets will be assigned a little later, after we learn about how many ladies there are to partake of this entertainment. If the number does not exceed the number that the committee have made arrangements for, all of the ladies registering will be provided with the tickets free of charge, but otherwise the committee will be obliged to carry out the programme under the rules as laid down. Every member of any association in the country attending this meeting is entitled to one of the souvenir badges, and can obtain them from the clerks in the room to the north. Should any member desire more than one of these badges to carry to his daughters, if he has more than one, he can obtain them by paying $2.50 for the extra one. These badges are a special design made for the gas men for this meeting by a jewelry house of this city, and gotten out as nicely as this committee were able to do with the means at hand.

The President—I take great pleasure in calling the Association to order to listen to a paper by our esteemed good friend from New York, Capt. William Henry White. Owing to absence abroad Capt. White was unable to have the paper printed in time for distribution, so I will therefore ask you to more particularly follow the reading.

Capt. White—I may say first that it rather dignifies a rambling Capt. White talk to be called a paper; therefore, it is a "talk." I believe the paper is scheduled as a paper upon "Low Candle Power Gas." As I begun in my last hurried moments to write it I finally found it was entitled,

SOME THOUGHTS ON CANDLE POWER,

and with your kind assistance and forbearance I will proceed.

Then Capt. White read as follows:

I may preface this paper by frankly admitting that it is not intended to be a scientific treatment of the subject presented, nor will it contain carefully prepard analytical tables of the various gases produced in this country, pointing out their illuminating or calorific values, nor giving hair splitting comparisons of actual or suppositious costs of these gases. Rather will the paper give some of the impressions of the writer that have grown along with his observations and experiences in a long business lifetime, spent in the gas industry and in its various departments, extending from the coal shed to the president's desk. During this generation of experience many changes have come and gone, leaving little mark upon the industry, while a few have survived the test of use and time and are to day standard practice with us. One lives to learn in the hard school of practical workings that change is not always the sure forerunner of improvement, and that nothing is either half so good or half so bad as its promise when first met. It has been falsely said that "a lie well stuck to is as good as the truth," yet we do live to see occasionally an error in judgment, a misconception of a scientific truth, become so fostered by circumstance and bolstered by an apparent great need as to become, for a time, the accepted practice of an industry or a community. We have seen in our industry a decided blunder in gas making theories taken as a great and valuable change in our methods and theories, and, thriving on our thoughtless acceptance of the claim, develop into an established practice that has cost both the gas manufacturer and the consumer vast sums of money, needlessly wasted, that were of questionable benefit to anyone concerned. Yet, at the time, this change was hailed as the greatest achievement of that day. We now see more or less clearly, according to our light on the subject, that this change became the rock of offense and a stumbling block to our feet in the pathway leading to the real, scientific and natural development of our industry, along the best, indeed, the only legitimate line of its development. I think that but few of this audience can hark back with me in memory to a personal participation in the work of the gas man at that interesting period in our history, when the clay retort, and its handmaid, the exhauster, had just won their place to a permanent place among the family of gas apparatus, when high heats was the dawning possibility with us, and the more daring among us were hitching their five-feet-to-the-pound wagon to the star of progress. Then came to us the first real awakening that set us to climbing the rugged road of progress that has led to the remarkable mechanical condition of the gas plant of to-day and the development of the profession of gas engineering to its present high plane. Those days, too, marked the beginning of the end, the passing as it were into the realm of pleasant memory of the genial, kindly, old-time gas maker, who, but lightly burdened with scientific knowledge, chemical or mechanical information, fought his way to the front of an industry that had then to borrow from all the other professions, and make precedent and history as a part of each day's work. These men who by dogged sticking to their daily worries and problems and, pioneer like, hewing their way through the unknown forests of gnarled and troublous questions, honestly giving to their consumers and owners alike the very best of their earnest usefulness, laid firmly and deeply the foundations upon which the successful gas engineer of to-day is erecting the structure of his prosperity. Grateful memory is due to him now, that he who then had no betters, as he passed off of the stage of active life and its labors.

The gas engineer has never had an easy time from the day that Wm. Murdock lit the first bilious-looking, evil-smelling coal gas flame in far away Scotland, down to the trained engineer of to-day, who, controlling the best of appliances and unstinted capital, still stands unsatisfied and questioning, contemplating the great, far-reaching problem of his business life.

Now, what is that problem when reduced to its essence? Is it not that we have, after vain wanderings, gotten back to the original purpose, the one real reason for the continuing existence of gas making as a business that flourishes in spite of all competition? That is the demand of the public for a cheap, cleanly gas of good heating value applicable to all, and sundry, the varied purposes of fuel, lighting and power uses. A gas equally useful in incandescent or flat flame burners, in heaters and ranges, and that will induce a wider use of the gas engine with its marked adaptability to such a wide field of usefulness, for which its cleanliness, efficiency and economy so amply fit it. The great need of the hour is a gas measured rather by its excellence as a heat producer than its showy quality on an official photometer as an illuminant. We all know that to-day, in any well handled gas property, more than 50 per cent. of the output is consumed for purposes other than illumination, purposes in which its illuminating value is of no benefit and its heat value becomes of supreme importance.

This being the problem before the industry, perhaps, harking back for a moment, the "old timer" who was content with an output of 16-candle power gas in the large cities and 14-candle power in the smaller ones, was not so far wrong after all, nor so fast asleep at his post as we youngsters who came along to disturb his peaceful and complacent hours with our talk of newfangled processes and improved machinery then thought him to be. He evidently was sitting at the doorway of great riches, but seemingly was not aware of it then. It is a vast field for speculation as to the might have been, should we undertake to consider the immense saving of money and energy had those pioneers of the business been enabled to improve machinery, methods and output so that the solving of this problem of a proper gas supply had been retained in their hands, instead of being handed down to the men of to-day. Apparently neither the gas man nor the consumer was ready then, nor was the time ripe for the full fruiting of the tree of opportunity. Marvelous and devious are the ways along which great worldly changes and human benefits come about. So all through—30 years ago we were standing at the threshold of what is yet to be the great final evolution of the gas industry; we stood as men devoid of sight, hearing and understanding. Both the gas maker and the consumer had to be prepared by a period of educational development so that the scales might fall from our eyes, our ears be opened and the light of understanding illuminate our road to the better ideals. Then it was that the voice of the promoter and his satellite, the process inventor, was heard throughout the land. And we blindly began yet another search for the mythical golden fleece with all the incidental wanderings into strange promised lands, its moving adventures, its costly experiments and the nourishment of ill feeling among the fellows of our craft. But now the rising sun of the newer, truer thought sees the battered barks of the weary wanderers, hurrying back into port, seeking rest in the old, safe home harbors of the settled axioms of the fathers of the industry.

And the promoter; what of him? Well, the city fathers and the dear public they represented believed the glittering tales he told and saw old Fortunatus pouring out his treasures on their respective communities, until no city was really modern and up-to-date that did not harbor at least one opposition gas company. Here let us stand for a moment at the cradle side of that enfant terrible, that degenerate scion of the gas industry. High candle power gas—sired by the greed of the promoter, "dammed" by petroleum, out of old mother earth—this fateful child has cost our industry millions of dollars and checked its true development for a quarter of a century. The wicked fairies surely attended that birth and left behind a very Pandora-box of evils for us all.

Once the public mind grasped the fallacious theory of the promoter, that it was being cheated at every turn, it wakened to its great power for harm and began to demand far higher candle power than could be utilized, and placed embarrassing restrictions upon all semi-public utilities, until to-day we face almost socialistic conditions in dealing with cities, and find it daily growing more difficult to meet the proper

claims for a good and cheap gas and to balance the ledger on the proper side of the profit and loss account. What an aftermath is this we are reaping from the once fairly fruitful field of our industry, and are now storing in the barn loft of hard-won experience from this careless sowing of the whirlwind of patent process gas of any old candle power. Many who found profit then are willingly seeking safe cover now. For a moment let us consider what the dear public got in all these years of riot. Well, it got better service along most lines, a gas that figured well in photometer records, and looked well in the flame of the specially adapted, high priced burners in the gas office, but did not develop much better light in their old-fashioned corroded burners at home. The then new lava-tipped burner, with which the new gas man came to their aid, promptly put a fine frieze of smoke on the side walls and frescoed the ceilings of the homes of the consumers in dark neutral tints. Really, nothing substantial reached the public, save a brief-lived reduction in the size of the gas bills, while the competing companies were reaching the inevitable conclusion of hostilities by purchase of the intruder or a division of the territory served. After that the consumers paid the interest on both capitals and got what was left—got it, too, where the dear public usually gets it!

The practical object of this paper is to assert that the excessive enrichment of illuminating gas in America, which has marked our practice for years past, has been so much wasted money taken from the pockets of stockholder and consumer alike. For while the former has been paying his money to produce and maintain an unnecessarily high standard of gas illumination, which the latter has not been able to fully avail himself of, but paid for his share of the burden of its manufacture in the high gas rate involved in the transaction. In educating our consumer to exact a high candle power gas, we have for long years been working at the wrong end of the problem of lighting supply.

Really we have been maintaining a sort of "Circumlocution Office" and have succeeded in training ourselves to know "How not to do it." For all these years the dumb, unspeaking burner has been our enemy; sitting in our camp and directly under our daily observation it has steadily nullified our best efforts to give the consumer that "twenty-two," or better, candle power gas that he was paying for but seldom getting. Here was the neglected point of attack for our inventive abilities, upon which so much then and now depended. We well know that gas of a given candle power can range through a wide gamut of illuminating value, dependent largely upon the character of the burner in which it is consumed. That this is the statement of a fact a glance at any one of the many tables of gas and gas burner tests will verify. The burner best adapted to the character and quality of the gas to be consumed will alone develop the best illuminating or heating values of the gas tested. Your 20-candle gas can be anything, in its efficiency, between the range of say, 80 or 90-candle power on the incandescent burner to 7 or 8-candle power on the small and poorly adapted flat flame burner—with the average burner in the average household in in our cities, 10 or 12-candle power must be a fairly general average of the lighting results had. This being true, why do we continue to tax the income of our companies that we may send out to the consumer a quality of gas that he does not secure the benefit of. Our contracts call for it and the consumer pays the bill.

Part of the work yet before us is to re-educate our public to know the truth, and the truth shall yet free them from the effect of our great blunder. It may be said that as yet in this country there is no loud call for the new gas method. Well, perhaps not from that lessening percentage of our consumers who still use flat flame burners, and gas only as an illuminant. But are we not daily in touch with our real consumers who, for fuel and power purposes, urge on us that a cheaper gas of good heat value is their great need, and do we not know, past all doubting, that if we could only send out a good, well made gas, having a heating power of say 550 to 600 heat units, that could be sold cheaply and still earn dividends for our owners, that our business would develop more rapidly than our gas works could be increased in manufacturing capacity? Saved from the increasing dangers of the incandescent electric lamps by the timely discovery of the incandescent mantle with which Dr. Auer Von Welsbach came timely to the rescue of our industry, have we not learned, through that piece of almost miraculous good fortune, that to-day our industry stands upon an entirely different plane from that occupied by it 20 years ago? A plane which the greater part of work is to be done for consumers having not the slightest interest in the initial illuminating power of the gas, other than in so far as it may be a factor in assisting in the production of heating power. Every year in well handled gas companies the number of consumers who depend entirely on the flat flame burners grows smaller, while the incandescent burner users grow steadily in numbers. Probably to-day 75 per cent. of the gas business is free from the trammels of the question of illuminating power. Is it not time for us to get to thinking and to applying our thoughts? As Rameses of old said of the Egypt of his day: "I set the boundaries of my country where I choose." Is it not equally true in our case that, by the zeal and energy with which we attack this question of heating gas at popular prices, we too may be able to set the boundary of our gas domain where we please. It is a business truth that you have only to find something that the people need; let them know that you have it, then sell it cheap enough and your fortune is assured. Now, more than ever, we need that triumvirate of good things in our business—good cheap gas, good cheap burners, good, well paid, brainy gas men. Germany shows what can be done in one direction, for practically 90 per cent. of its gas output for illumination is used on Welsbach burners. Of course, we have some disadvantages over here as to high prices of burners and mantles, but we can and must get there.

I have purposely refrained from setting up my standard of illumination for the lower priced gas that is yet to come into use, enabling us to enter upon and control this vast, unoccupied field now lying just outside of our own special farm, as I readily foresee that the steps downward and backward, the troublesome undoing of our well-meant work of the past, will call for tact and diplomacy, concessions, and an educational campaign that will test our best selves. So we will work that out at first, each for himself. But whether we land at 16 or 18-candle power, or drop back to lower levels, will depend on what we develop while keeping the standard of calorific values, which we may adopt, before our eyes. For we may as well begin to accustom ourselves to missing the bar photometer from its high place as the fetish of our business; for it must join grandmother's spinning wheel in the old garret, the limbo of outused things.

The pyrometer and the calorimeter for us in these days. These shall be our guide and compass in the new days, while a watchful eye will be kept on the simple chemical test apparatus that will note for us the presence or absence of our necessary friends, marsh gas and its bevy of sister hydrocarbons of riper and richer usefulness to the gas man. For on this family much dependence must be had. Then it will not so much matter what the name of the process may be or what marks the photometer would give your gas, so long as the finger of the calorimeter points steadily to the chosen mark of B.T.U.

I feel that we are now sufficiently well equipped in plants and trained engineers to commence this work of development, and wish now, lest I may have been misunderstood, to say that I fully appreciate the value to the industry of the splendid apparatus of the modern carburetted water gas plant.

This gas has come to stay, and the apparatus is a tried and approved part of the accepted machinery of the gas works, having long since proved itself a valuable addition in many ways to the coal gas works and a most valuable standby in times of need and trouble. The part it is to play in the future is as well assured as is its present status. I do believe, however, that, owing to its many advantages, coal gas must stand as the backbone of the cheap heating gas suggested, for from it must be obtained the necessary supply of hydrocarbons to produce the heating value of the gas, and the coke for use in the water gas adjunct.

The development of proper burners, both flat flame and incandescent, needed to secure the best lighting results and all the questions involved in the economies of this work, necessary changes in methods and apparatus at the gas works to secure any possible increase in the volumes of make per unit of apparatus, and the lessening of the cost of the gas at the burner, I can safely leave to the capable hands of the American gas engineer, who, with the brother mechanical engineer and the gas chemist must solve all these questions. This is an age of machinery, and I am content to believe that through its aid much may yet be accomplished in lowering the cost of our output of gas.

Before us lies the promised land, flowing with the milk and honey of opportunity to those who have the courage to cross the Jordan of their doubts and occupy its fruitful valleys.

(To be Continued.)

[Continued from Vol. LXXX., Page 1,009.]

Contents of the Question Box as Read at the Twentieth Annual Meeting, Ohio Gas Light Association, Cleveland, O., March, 1904.

No. 42. "What general laws can be laid down to secure fuel economy in a gas works?"

"By firing a given quantity at a given time. Same as charging.—E. C. FLEGER."

"Teach the foreman or gas maker to check up each month all materials received and used, taking careful inventory at end of each month, in order to show up discrepancies.—CHAS. F. CATTELL."

"There are different ways to economize in fuel in water gas works. If blast is continued too long, the bed is consumed to no advantage; also, the use of too much steam under the fuel bed tends to deaden it. The only thing remaining to be done is to clinker, whereby we lose a great deal of good coke if not separated and turned back to firepot.—E. W. SMITH."

"Properly constructed benches and good management of same.—JOHN GIMPER."

"This answer will apply only to a water gas works, which is the kind now under my care. Do not crowd your boilers; have ample grate and steam capacity so as to consume your fuel slowly. Locate your boilers as close to your generating apparatus as practicable. Use only up-to-date apparatus, taking care to have ample depth and area in generator, and then use brains as well as muscle in operating same.—Z. M. JENKS."

"Prominent among other sources of fuel loss in a gas works are the use of direct acting steam pumps and small isolated steam engines, which, between condensation, leakage and general inefficiency of design will absorb from 4 to 5 times the power required by using a central power plant and electrical distribution.—R. B. BROWN."

"Use breeze for boiler fires. Fire up frequently in furnaces; every 2 hours is better than every 3. If furnace is allowed to get low clinkers will be the result, while if kept full up the consumption of coke will be much reduced.—W. E. BLOWN."

"Proper attention to drafts and dampers; strict attention to practical rules by men when firing; steam pipes properly covered; use of high grade fuel. Above all, a foreman or superintendent who understands his business, with the ability to enfurce rules and instill into the minds of his men economical ideas.—B. C. COBB."

No. 43. "Have any new labor-saving machines been brought out during the past year?"

Yes; a very good ditching machine, which has been used successfully among other places at Sioux Falls, S. D.—FRED. H. BECK."

Mr. G. A. Bronder, replying to this question, described his improved retort charging and drawing machinery; also, his coke quenching conveyors, conveyors for moving coal and coke from cars to storage shed, improved turntables, etc.

No. 44. "Would it pay to put dampers on the stack of each bench, with convenient means for closing to prevent cooling by air currents, whenever furnace is opened for clinkering or recharging?"

"That a damper, and a separate one at that, for each stack is requisite has been demonstrated in our works during the last 35 years. In order to work benches profitably, it is of first importance to maintain high, uniform heats. It is, I believe, the general practice in works to clinker every morning and night, and in doing so it is necessary for the stoker to rid his furnace of the fire in order that he may cut off the clinkers from the sides and rear end, during the operation of which there is a vast amount of cold air passing through the bench and which quickly begins to tell on the retorts by their cooling and contraction. The stoker is the first who is made cognizant of its first effect in the chilling of the clinker he is cutting, which renders it more difficult to cut and prolongs the operation. During all this time and until the coke is again ignited from the sides of the furnace (the latter having lost considerable of its heat in the meantime), the temperature of the retorts has decreased from that of white heat to one approaching a dark color. To this cause is mainly due the rapid destruction of retorts, as no material will long stand the sudden and rapid changes of temperature which a bench of retorts worked at a high heat is subject to under their present arrangement. A stack damper will save the retorts this great variation in temperature, and will also materially increase the ease and rapidity with which the furnace may be clinkered on account of the clinkers not getting chilled.—E. J. CURLEY."

"With straight fire furnaces, using coke for fuel, dampers on the stack of each bench are desirable, and will pay by retaining the heat of the bench during clinkering and firing. With coal firing, however, my experience is that the use of dampers tends to clog up the flues leading from the furnaces, and I would not recommend it under such circumstances.—O. O. THWING."

"It pays to put a damper on each bench. *Be sure* to have handy means to work them, so the men will not have to *climb* to operate said dampers.—CHAS. F. CATTELL."

"Yes, for open fires; but would be dangerous for regenerators.—WALTER THOMAS."

"Yes, but dampers must be automatic, and a good automatic damper is badly wanted. The rush of primary air during clinkering and filling up the furnace has a very destructive effect on the bench.—W. E. BROWN."

No. 45. "Is it not possible that air would be more effective if introduced at a point nearer the purifiers, than if introduced immediately behind the exhauster? Nitrogen is inert and objectionable, while oxygen is an active chemical element, and a portion of the oxygen of the air may be absorbed by the scrubber water and tarry matter, or may unite chemically with other portions of the gas, and never reach the purifiers as free oxygen."

"Yes.—JOHN GIMPER."

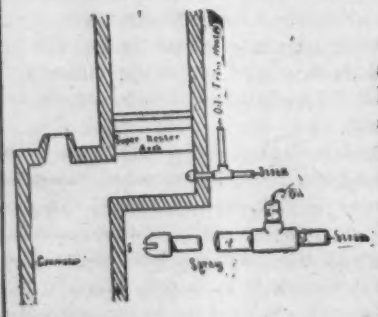
"The only proper place to admit air for revivification in situ is at the inlet of the purifiers. If the proportion is correct, there need be no trace of it (except the nitrogen) at the outlet of the purifiers, and no chance need be taken on cooling too suddenly such portions of the gas as will be met by the air at the point of introduction.—HENRY I. LEA."

"Some engineers claim that they do not lose in candle power if the revivifying air is introduced close to the hydraulic. The claim has been made that, with a specially designed appliance, much more than the usual per cent. of air can be introduced close to the hydraulic without injury. As there appears to be much difference of opinion as to the absolute effect of the introduction of revivifying air on the candle power, and as the information available is much confused by the different methods of application, and by the facts sometimes relating to only coal gas or again to only water gas or to mixtures, and as the oxygen present in the gas from various causes is another conflicting element in results cited, the writer feels that the subject is one worthy of special research such as has been devoted at times to various questions in our Association.—H. L. RICE."

"It would seem a good plan to introduce air at a point near the purifiers, as 100 volumes of water at 60° F. and 30 inches pressure will absorb 2.99 volumes of oxygen, which is undoubtedly absorbed by the water in the standard scrubber when the air is introduced behind the exhauster.—J. A. SCHAEFER."

"Owing to the fact that gas comes to the exhauster saturated with different gases including oxygen, and also the fact that the temperature of the gas is steadily decreased after passing the exhausters, I believe it makes no difference at which point the air is introduced. We introduce ours before the exhauster.—CLARENCE S. LOMAX."

No. 46. "We have manufactured gas with the Granger's water gas system since 1882, and we are very much pleased with the plant; but the oil is thrown cold directly over the generator. Is there any other way to distribute this oil in ebullition over the generator or at the bottom of the heater with advantage?"



"We use the Granger-Collins water gas apparatus in our works, and for the past 6 or 8 years we have vaporized our oil by means of an oil heater in the gas take-off pipe, and have introduced it into the bottom of the superheater about a foot below the superheater arch. The oil is forced into the set with a pump, but a jet of steam is introduced into the oil just before it enters the set to thoroughly spray it and insure its meeting the gases as they come from the generator in a fine mist. With this arrangement we get an average result of about 5½ candles per gallon of crude oil; gas corrected for temperature in determining gallons per foot. Our spray consists simply of a piece of pipe with a cap on the end of it with a slit in the cap ¼ inch wide. When spray is put into set, the slit is set horizontally.—E. D. CLARY."

"Force it through heater, then spray it over fuel. Think a small Lowe setting would save enough in a short time to pay for itself.—E. M. OSBOURNE."

"An oil heater heated by steam of high pressure would probably be advantageous in this case.—ANONYMOUS."

No 47. "How long should the checkerbrick be used in the carburetter or superheater of a water gas set without changing?"

"There is no fixed time at which the bricks in the carburetter and superheater should be changed. It depends a great deal on the oil at command; some oils deposit more carbon than others. The principal

way that a water gas maker determines when the bricks are dirty and need cleaning is by the decrease in the make of gas per minute. The carburetter and superheater should be put in good shape in the late fall, so as to be in good condition for the heavy make in December and January.—C. W. WALLACE."

"Checkerbrick in the carburetter and superheater should not be replaced until the increase in oil and fuel per 1,000 shows that they are covered with carbon and burned out. This condition will generally result after the machine has been run about 2,000 hours.—LEONARD FITZGERALD."

"No set time can be given for using brickwork in carburetter or superheater, as it depends very largely on the way the machine is run and the quality of oil used. On a small set of improved Lowe I can call to mind, when averaging 80,000 cubic feet per diem, we had to change the checkerbrick in about 2 months. Our rule was to change when the results obtained fell so low that it was economy to put in new bricks.—B. F. BULLOCK."

"That depends on many conditions—work done, heats carried, oil used, coke or other fuel used. All have a bearing on the time when checkers cease to be economical. Large machines running heavily or continually in Chicago plants are changed every 3 or 4 months. They now use a cheaper brick than formerly, and seldom replace them, throwing them out after one using. Some plants use best brick for top of superheater.—E. M. OSBOURNE."

"The checkerbrick in carburetter and superheater, being absorbers of heat, will perform that duty best if placed with spaces of 1 inch between; have found them to work well as long as the brick should be left unchanged.—H. H. POWELL."

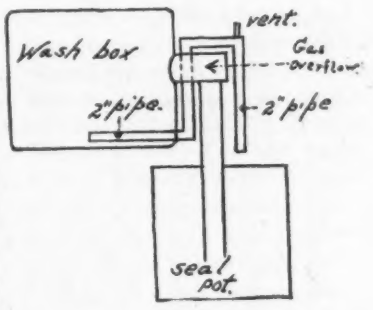
"The frequency with which the checkerbrick of water gas apparatus should be cleaned will depend upon the kind of fuel and oil and the conditions of running. With a good fuel which does not produce a great quantity of dust and small cinder, and with a good gas oil and proper heats, superheater bricks should run from 3 to 4 months continuously day and night without cleaning, and carburetter bricks should run from 1½ to 2 months. The condition of brick should be carefully watched through sight holes, however, and the back pressure in carburetter and superheater during blasting should he noted; if these denote a considerable deposition of dirt on the checkerbrick, the brick should be cleaned.—ANONYMOUS."

No. 48.—"How would you prevent carbon from forming in the take-off pipe of a water gas set?"

"Carbon is not formed in the take-off pipe of a water gas set. Its deposits there cannot be entirely prevented, but may be largely reduced by continued, careful watching of the seal overflow pot, of the temperatures throughout the apparatus and of the color of the gas at the top of the superheater. The depth of the seal will ordinarily care for itself after water supply has been adjusted. This adjustment, by the way, is varied so that from 7 to 11 gallons of water per 1,000 feet of gas made are run into the seal. A large portion of this water is, of course, picked up mechanically by the hot gases passing through the seal, the balance being that which appears at the overflow pot, the surface of which must be watched as an indicator of the condition of the gas as it reaches the seal. If lampblack is being formed in the set, the seal pot will, of course, show lampblack. On the other hand, if the oils are not being properly fixed, oils will show on the surface of the seal pot. The careful gas maker will stay between these two points and will aim at obtaining a clear tar, showing, with reflected light, traces of yellowish gold. The exact consistency of the tar at this point and the shade of color obtained will be determined by the particular grade of oil being used, even when assuming that the best conditions obtained in each case. Similarly the color of the crude gas leaving the superheater will be affected by the quality of the oil and the details of operation; ordinarily the best results are obtained when the opening of the superheater sight cock shows crude gas of a golden-straw tinge. The exact shade suited to any one oil may be determined with a little practice, as the variation in color, owing to the different proportions of hydrocarbons going through, may be readily noticed through any one run. If instead of having the rich straw color, the gas at this point appears more as blue smoke, it will be found unsatisfactory for illuminating purposes, as the blue indicates a drop in the proportions of the hydrocarbons present. On the other hand, gas may readily be made too heavy and this would be indicated by a density in the cloud of gas issuing, and by the presence of noticeable particles of lampblack, if the excess be carried far enough. It is impracticable to give any set rules for the operation of a water gas plant, but it is safe to say that, with any of the crude and gas oils ordinarily used, a gas of rich straw color at the outlet of superheater, coupled with clear tar having no indication of either lampblack or oils on the surface of the seal overflow pot, is an indication that a fixed gas of ordinarily satisfactory illuminating value is being made.—HENRY I. LEA."

"This carbon is formed as a result of the gas being exposed to so high a temperature that the hydrocarbon constituents are decomposed into their elements, hydrogen and carbon, the carbon being deposited in the take-off where it becomes caked upon the inside of the pipe. This carbon is formed at the expense of the hydrocarbons or illuminants in the gas. To prevent it, study the heats. There should be a gradual decrease in temperature in the machine from the top of the superheater, which should be coolest. To secure this graduation of temperatures, we used successfully two steam connections, one at the bottom and one two-thirds of the way up on the superheater. By turning on one or both of these during some of the blows, we can keep down the temperature to the desired point. On another machine we respaced the superheater checkerbrick, leaving 4 inches space between bricks. By thus decreasing the heating surface, we find that we can carry the desired heat without the aid of steam.—W. E. HARTMAN."

"By keeping the temperature down in top of superheater.—J. D. SHATTUCK."



"At our Milwaukee plant we found what we consider to be an effectual means for preventing the deposition of carbon in the take-off pipes of our Lowe sets. We tapped all of our washboxes on the side and as low as possible, and have inserted 2-inch pipe as shown in the accompanying sketch. It will be seen therefrom that when the run is on, the increased pressure in the box will cause the water and tar to be discharged through the 2-inch pipe into the seal pot, thus keeping the bottom of the washbox clear of tar and pitch. A vent at the top of the bend prevents any siphoning action.—J. WALLACE SCHAEFER."

"Think this is caused mostly by too high heats. We often run steady 8 weeks or longer, yet have no take-off pipe trouble; but I have seen it plug solid in one day, making it necessary to take down the whole take-off pipe.—E. M. OSBOURNE."

"The deposition of carbon in the take-off pipe of a water gas set should be prevented by maintaining sufficiently low and regular heats in the checkerbrick, so that no lampblack is made in the machine.—ANONYMOUS."

No. 49. "What effect does high heat have on the production of ammonia per ton of coal carbonized?"

"The effect of high heat lessens the production of NH_3. A make of from 9,500 to 10,000 cubic feet per ton results in the greatest yield of NH_3. The loss of NH_3 at high heat is expressed by the equation

$$NH_3 + C = HCN + 2H,$$

NH_3 being decomposed into hydrocyanic acid and free hydrogen.—ROBERT LINDSEY."

"High heats appear to increase the formation of cyanides at expense of ammonia production. Maximum product of ammonia is reported by a good English authority to occur at medium heats such as will produce with good coal 10,000 cubic feet of gas to ton.—WALTER M. BLINKS."

"It lessens the amount produced, probably due to dissociation.—E. E. EYSENBACH."

"Below 500° C. is the best temperature for maximum yield of ammonia. At high carbonizing temperatures, ammonia is very unstable, being decomposed into its constituent elements, nitrogen and hydrogen, this decomposition increasing with the temperature—W. E. HARTMAN."

"Anything above a moderate heat has a tendency to lessen the amount of ammonia made per ton of coal.—FRED. H. BECK."

"With most coals high heats reduce the production of ammonia per ton of coal carbonized.—R. B. BROWN."

No. 50. "Is wash water taken from and returned to relief holder tank successfully used in water gas practice?"

"Yes; sometimes by pumping relief holder water through the condensers and then back to relief, using independent water supply for

scrubbers. At other times the principle employed in 'domestic' hot water circulation is taken advantage of and a separate boiler is used for maintaining circulation. This arrangement renders it impossible to form steam in the boiler and avoids practically all danger.—HENRY I. LEA."

"Messrs. Chas. F. Cattell, Fred. H. Beck and E. M. Osbourne, answer, 'Yes.'"

"Water from the wash box can be successfully run through a relief holder tank and used repeatedly. As this water contains sulphuretted hydrogen, etc., it cannot be run into a storage holder tank without fouling the purified gas.—ANONYMOUS."

No. 51. "Assuming that some coal must be stored to insure a supply at the works, is it better to leave the same coal stored all the time for any emergency that might arise, and use fresh coal as far as possible, or is it better to use the oldest coal; and should the old coal be cleaned out once a year?"

"The answer to this question depends greatly on locality. Some coals lose but little by storage, while others rapidly deteriorate. Slack coal in British Columbia loses 40 per cent. of its gas in 12 months.—W. E. BROWN."

"On account of slacking and constant deterioration of the gas making qualities of coal, it is advisable to use the old coal first.—J. H. NELSON."

"This depends on quality of coal; should it break much on storage it should be cleaned up as often as possible, as fine coal oxidizes more rapidly. With coals that do not slack the chief depreciation occurs the first year, and assuming a proper building is provided for storage it will be better to carbonize fresh coal and not touch the reserve supply. No consideration of the desirability of using up and checking coal stock is taken in this.—WALTER M. BLINKS."

"As the rate of depreciation of coal decreases by time, the actual percentage of value lost is less if the stored coal is unused until emergency occurs, when its use is necessary.—NEW YORK & RICHMOND GAS COMPANY."

"Oldest coal should be used first, and should be cleaned out once a year, if the coal shed is so arranged that it can be gotten at without any extra expense.—E. C. FLEGER."

"If coal is small, it is best to clean up coal storage once a year. Find it more profitable to use fresh mined coal.—WALTER THOMAS."

"It is our opinion that the old coal should be cleaned out once each year.—ALTON LIGHT AND TRACTION COMPANY."

"According to a thorough investigation of this question, recently made by Mr. Garnet McKee, of the Detroit City Gas Company, we should charge the freshest coal first, especially the fine stuff, and let the oldest coal remain in storage indefinitely or until needed.—IRVIN BUTTERWORTH."

"Use fresh coal, for in most plants it can be more economically handled, and it is questionable if coal in protected storage deteriorates enough to make it wasteful.—B. C. COBB."

No. 52. "Has any progress been made in this country towards the commercial recovery of sulphur and cyanides?"

"There are a number of factors which contribute in making the success of the recovery of cyanides in the United States rather questionable. These may be summed up under two captions:

"(1) There is a great accumulation of stock of cyanides on hand in Europe, which accumulation has been caused by shut-down of the Transvaal gold mines during the Boer war. As is well known, the cyanides of potash and soda are used extensively in the extraction of gold from its ores.

"(2) A number of processes are now being exploited for the manufacture of cyanides synthetically from its elements or by the conversion of ammonia. This latter process is now being used in a factory at Perth Amboy, N. J. The United States patents on this process are the following: 708,079, 708,333, 711,910 and 716,350.

"In this process a mixture of metallic sodium and carbon is heated to a temperature of about 660° to 750° F., and ammonia is introduced. The following reaction then takes place—sodium and ammonia form sodium amide: $Na + NH_3 = NaNH_2 + H$. This sodium amide is then furthermore converted into sodium cyanamide, according to the following reaction: $NaNH_2 + C = Na_2N_2C + 4H$. This sodium cyanamide is then at a temperature of about 1,470° F., converted into cyanide of sodium, according to the following reaction: $Na_2N_2C + C = 2NaCN$. The sodium used in this process is manufactured electrically at Niagara Falls. Another process has been vividly discussed at the recent Congress of Applied Chemistry, Berlin, 1903. This process, which has been invented by Frank & Caro, will be exploited on a large scale in the factory in course of erection in Switzerland. Frank & Caro had specially in view the production of cyanides as being the more valuable combination of nitrogen. For this purpose they used at first barium carbide, because it fixed the nitrogen directly according to the equation: $BaC_2 + N_2 = Ba(CN)_2$. The barium cyanide obtained could be worked up into potassium ferrocyanide and alkaline cyanides. Further investigations showed that, to better advantage, calcium carbide could be used, the manufacturing of which is more economical than of barium carbide. The product of the reaction ef nitrogen upon calcium carbide in red hot iron muffles is calcium cyanamide:

"(1) $CaC_2 + N2 = CaCN_2 + C$.

"By extraction with water, and by remelting with carbon and carbonate of alkali, cyanide is obtained according to the following equations:

"(2) $2CaCN_2 + 4H_2O = 2Ca(OH)_2 + (CNNH_2)2CNNH_2)_2$.

"(3) $(CNNH_2)_2 + Na_2CO_3 + 2C = 2NaCN + NH_3 + H + 3CO + N_2$.

"There are a great many other processes of similar nature which it would take too long to describe. Anyone who desires to post himself regarding the present state of industry can do so by perusing a recent publication, 'L'Industrie Des Cyanures,' by R. Robine and M. Lenglen, Paris, 1903. The question is now whether these processes will be able to manufacture cyanides as cheaply as they can be obtained by working up the spent oxide of gas works or by the direct extraction of cyanides from gas, as is done extensively in Germany under the Bueb patents. This question cannot be decided at the present moment, as our knowledge as to the manufacturing expenses is too limited, and strict secrecy is being preserved in regard to these manufacturing expenses. It would, therefore, appear unwise at the present moment for anyone to spend large amounts of money in the equipment of gas works for the recovery of cyanides.—THE UNITED COKE AND GAS COMPANY."

"The recovery of cyanides has very little commercial promise. The best reason for removing it is to save meters and service pipes.—E. E. EYSENBACH."

[To be Continued.]

Lost and Unaccounted-for Current.

In the report of the Boston meeting of the National Electric Light Association reference was made to the paper by Mr. C. W. Humphrey with the above title, and owing to its exceptional interest it is reprinted below in full, excepting a few of the sheets of tabulations.

The object of the paper was stated to explain in full the calculations of losses, known and unknown, for alternating and direct-current circuits, and to give the records of some of the results obtained and tabulated during the past two years. Most of the data given was compiled from results obtained on the lines of the Denver Gas and Electric Company.

The lines in Denver are now all 2,400-volt, single phase feeders, but the calculations are approximately the same for all systems of distribution, regardless of voltage, frequency or phase. Even in high tension transmission lines the same methods may be used, there being no actual losses introduced by inductive drops. Most high tension lines, however, have integrating wattmeters on both ends of the line. The difference in the readings will indicate the total loss in transmission. This loss may be easily subdivided into resistance losses and transformer losses.

Direct current losses may be calculated in much the same manner as those of alternating current circuits, although resistance losses and meter shunt losses are all that must be accounted for. The "drop of potential" method was found the most satisfactory for calculating the line losses, following along the same lines as described for alternating current circuits (mentioned later). The meter shunt losses were taken care of in the same way as for alternating currents.

The different losses in an alternating current system may be classified as follows: Transformer iron losses; primary resistance losses; secondary resistance losses; meter shunt losses.

For the transformer iron losses there is a card index system consisting of two sets of cards. One set has a card for each transformer on the lines and also those in stock, and shows the date of purchase, where set, manufacturer's number and type, iron and copper losses as shown by test, and also whether or not the transformer has been removed and for what cause, as well as a retest on its iron loss before it is again placed in service. In fact, these cards show the entire history of each trans-

former from the date of p urchase up to the present time. The other set of cards, which is called the feeder index, shows the exact location, make and number of transformer, also the number of feeder on which it is located. These cards are arranged according to location and feeder, while the other index is arranged numerically according to the make and number of the transformer. The records are not as complete as the above statement might seem to imply, due to the fact that these records have all been started within the past two years, and do not include full data on transformers purchased prior to that time.

In a great many instances transformer iron losses were tested while in service. This was done in a very unique way and without interruption to service. There is a small testing board, which includes a wattmeter, voltmeter and a small variable resistance. To these instruments are attached two flexible duplex cables of sufficient length to reach from the ground to any transformer on any pole. The primary fuses of the transformer are pulled, the neutral of the secondary is disconnected (that is, if the transformer is on a 3-wire network), one side of the secondary is left intact and the other side is cut, and the wattmeter and resistance are inserted in the circuit by means of one of the flexible cables, the other cable being used for pressure wires. The secondaries are kept alive by the other transformers on the system. The resistance is then so adjusted that normal voltage is impressed across the secondaries of the transformer. Readings are then taken on the wattmeter, which indicates approximately the iron loss and may be corrected for instrument losses in the usual way.

There is also kept a transformer record sheet for the purpose of more readily finding the transformer iron losses as soon as possible after the first of the month. These sheets have a line for each day of the month, on which is placed the number of transformers of each size and make according to the different headings. On the extreme right of the sheet is a column for the total transformer iron loss for one day. This represents the total 24-hour loss on that particular feeder, which is the summation of all the individual losses pertaining to the transformers on each line. At the end of the month this last column is totalized, and this represents the total loss for the month on that feeder.

The next known loss to consider is the primary resistance loss. This loss has been more difficult to ascertain correctly and keep up from month to month than any of the other known losses. Four different methods of calculating this have been used and each different method and endeavor will be discussed to show the advantages and disadvantages of each.

The first method used was to measure up the length and size of wire in the primary feed, assuming 1 ampere to be flowing from the station to the first division point in the feeder, then assuming the current to divide proportionally to the connected load in each branch of the feeder; calculating and summing up all losses due to an initial flow of 1 ampere and using that as a constant. Then ampere meter readings are taken at short intervals at the station during a period of 24 hours. Each of these readings is then squared and multiplied by the constant. The summation of these losses will give the total primary resistance loss for one day. This method is fairly accurate, but is long and tedious and cannot be relied upon any better than other more simple methods. One point of error in this method is the fact that a suspended wire stretches in course of time, making its cross-section smaller than it was originally and, therefore, of higher resistance. Joints and junction fuses also introduce errors of more or less magnitude. The results as obtained from this system are always considerably smaller than actual measured results.

The author undertook to accomplish the desired result by placing recording volt meters at the station and at the center of distribution and then taking the difference between the two readings and multiplying by the load in amperes corresponding to the drop in voltage, and summing up as in the previous method. This would be a very satisfactory method if this drop could be ascertained correctly. A small potential transformer is usually employed for the purpose of stepping the voltage down for the recording voltmeter.

The ratio of these transformers, when used on a 2,400-volt feeder, would be 20 to 1. These voltmeters cannot be read with an accuracy closer than one volt; therefore, it means an error which must be multiplied by a constant of 20, and when two voltmeters are used, one at the station and one at the center of distribution, it makes a possible multiplication of an error by a constant of 40. This error amounts to considerable where accuracy is essential.

The next method used was to place an integrating wattmeter in the primary lead just before it begins to feed, running pressure wires for it back to the center of distribution. Readings were taken the first and last of the month, and kilowatt-hour readings obtained subtracted from that obtained on the station wattmeter for the same period. This is a very good method, provided there are no grounds or individual taps taken off between the two wattmeters. If this should be the case, the results obtained might lead to an erroneous impression.

The method finally adopted and now used exclusively is a measured resistance method. With the use of this method the feeder must be shut down at some convenient time, preferably during light load, and the primary fuses of all transformers pulled; that is, all those on the station side of the center of distribution. The primaries are then short circuited at this point and the resistance of the circuit is measured by the "drop of potential" method with direct current, the direct current being supplied from a separate direct current machine and the voltage varied so as to permit of a series of readings being taken. The loss is then calculated by means of ampere readings taken at the station at stated intervals, the same as in the first two methods. Or a better way than calculating each particular point is to calculate the losses for different amounts of current and plot a curve of watt loss and primary amperes. This curve also includes the primary copper loss of the transformer on the feeder, full load on the feeder being considered as the sum of the full load capacities of the different transformers. The readings taken at the station may then be readily run off on this curve and summed up for a period of 24 hours, full load copper loss of the transformers for the entire feeder being the sum of the individual losses for all transformers on the feeder. The copper losses of a transformer are assumed to be divided equally between the primary and secondary windings. This assumption has been borne out by tests. Fig. 1 is a curve showing the different primary losses as calculated above.

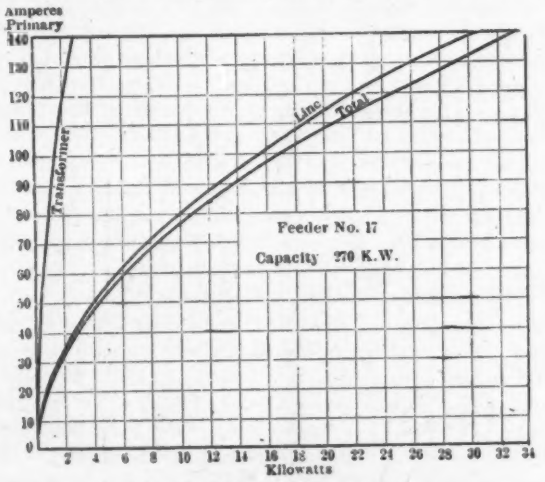


Fig. 1.—Curve of Primary Losses.

After losses are obtained for a period of one day, the total loss for the month must be calculated. This is done by multiplying the output on the feeder for one day by the number of days in the month and dividing into the total output for the month as obtained on the feeder wattmeter. This result is squared and multiplied by the loss for one day and multiplied by the number of days in the month. These results will be as close as it is possible to calculate them and would be very accurate if it were not for the fact that the characteristics of the daily load curve change during the different seasons of the year. The peak is very sharp in the summer with a very small morning peak, while in the winter the peak is quite broad and the morning peak is much more noticeable. For this reason these losses must be recalculated from time to time during the year as these characteristics change. Fig. 2 shows

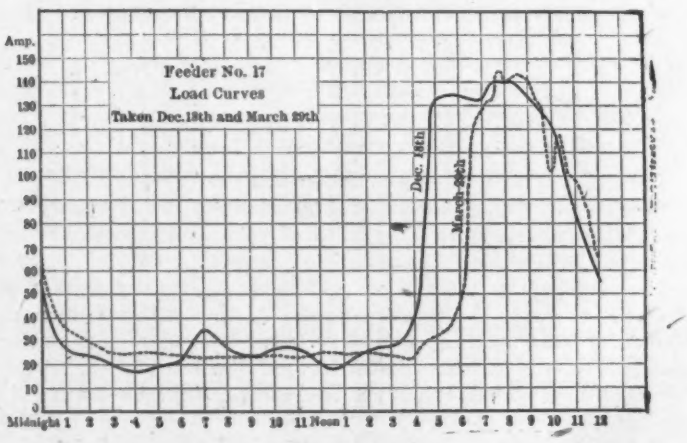


Fig. 2.—Load Curves.

a curve of one of the principal business feeders illustrating these different characteristics. The greater demand shown for March 29 is due to new business on that feeder. Evidence of new business is shown throughout the curve. Both December 18 and March 29 were clear days.

The kilowatt hours lost due to primary resistance for 1 year, multiplied by the actual cost of generation, will show whether reinforcements would pay financially and to what extent they might be carried. By cost of generation it means the variable costs, which vary as the output; it does not include any of the fixed expenses.

The secondary resistance losses are somewhat more difficult of accurate calculations. Following is the method which was used exclusively for the 3-wire secondary network.

In this calculation some things had to be assumed in order to arrive at results. The total secondary load is assumed to be divided up in proportion to the sizes of the different transformers, one-half the load on each transformer to feed each way, and this amount of current to feed one-fourth the distance between transformers. The assumptions have, however, been verified in each case by the testing of all transformers on the line. This assumption would not hold true, however, before the company began to test the transformers systematically and place them on the lines in accordance with the actual load carried, instead of depending, as is usual, upon the connected load. It was found that the actual load carried varied very widely from that calculated on a batis of connected load.

With these assumptions and the size and length of secondary feeds being known, the losses may be figured for several different amounts of current flowing, and plotted in a curve. The author also figured the loss due to current flowing in the neutral. but this loss was found to be negligible on his system of distribution, due to the fact that the transformers are so evenly balanced that there is a minimum flow of current in the neutral. This is not the case on the majority of distributing systems, as most of the transformers are in the same condition as his were before a systematic test was instituted by means of an instrument termed the "portable line meter." The instrument consists of an ammeter directly calibrated with a small series transformer having a 2-piece iron core hinged together so as to permit of its being opened and clasped over a wire at any point. With this instrument he has been enabled to measure the exact load carried on a transformer at any time, also the amount of unbalancing. The loss in the neutral does not vary as the per cent. of unbalancing and is, therefore, inappreciable for small amounts of unbalancing. But in most systems of distribution, where this unbalancing is quite considerable, it becomes an important item. Unbalancing not only increases the losses materially, but also decreases the available capacity of the transformer quite materially. It has been claimed that transformers banked together on a 3-wire network would adjust themselves to the total unbalancing of the feeder. This is not true, as the author found transformers of the same make and size on adjoining poles considerably unbalanced on opposite sides; and even in cases where transformers are banked together on the same pole, they will not divide their loads evenly. This was very strikingly illustrated by an occurrence that took place some time ago. During a breakdown in an isolated plant furnishing power for a theater, the author was called upon to furnish them with light. In order to do this he placed six 10-kw. transformers and one 20-kw. transformer, all of the same make and type, just outside of the building and connected them up for 110 volts, tying them together with a 500,000 cm. cable, which fed the theater. Following is the average load in amperes on each transformer during operation:

Size.	Load in Amperes at 108 Volts.
10-kw	106 amperes.
10-kw	93 "
10-kw	130 "
10-kw	112 "
10-kw	90 "
10-kw	90 "
20-kw	158 "

The author also took into consideration the resistance losses in the service loops. This is taken care of by assuming the secondary load to be equally divided between the different service loops, and taking the average length and size of a service.

The secondary transformer copper loss is taken into consideration in the same way as in the primary losses. A curve is then plotted of the secondary resistance loss, secondary transformer loss and service resistance loss, and then a curve of the total losses is plotted. A sample of one of these curves (Fig. 3) is here shown, watts loss being plotted against primary amperes.

The all-day losses are obtained in the same way as with the primary,

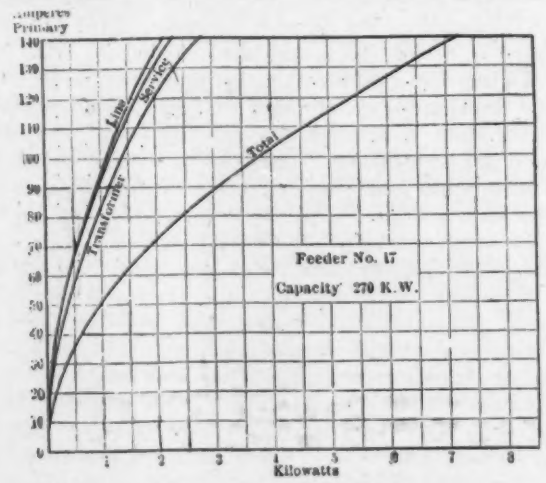


Fig. 3.—Curves of Total Losses.

using the station ampere readings in the same way; the station ammeter not being relied upon entirely, a standard portable instrument being cut in and used, and the switchboard meters being calibrated at the same time.

The only known loss now left to determine is the meter shunt loss, a loss that one might think at first hardly worth considering, but which is nevertheless of considerable importance and assumes very large proportions in some instances. The loss can be obtained with a greater accuracy and less trouble than any other of the losses. Each different type and size of meter must be tested and the average of a number of different tests taken. The author uses a meter record sheet for the meter losses on each feeder similar to the transformer record sheets. These sheets are kept up from day to day, and at the end of the month the daily losses are summed up, giving the monthly losses. It was found to be much easier to keep up the records in this way from day to day on the different feeders than to wait until the end of the month and then figure up the losses for the past month. It is also the most accurate, and the total losses may be ascertained much more quickly after the first of the month.

(To be Continued)

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. HENRY I. LEA, whose resignation from the service of the Western Gas Construction Company, of Fort Wayne, Ind., was recently reported in the JOURNAL, has accepted a responsible position in the gas producer division of the works of the Westinghouse Machine Company, of Pittsburg, Pa.

MR. JOHN R. Cullinane, who since 1886 acceptably managed the properties of the Dennison Light and Power Company, has resigned that charge in order to accept the place of Manager to the Texarkana (Tex.) Light and Power Company, in which concern he has acquired a considerable interest.

MR. C. W. LEE, who has much to do with the advertising department of the Pubic Service Corporation of New Jersey (his headquarters are the home offices, Newark, N. J.) has forwarded us proofs of a series (10 in number) of gas cooking range and water heater advertisements that are now being printed in the newspapers of the cities and towns served with gas by the Corporation. Write to him for a set. They can be had for cost and postage.

THE Directors of the New Haven (Conn.) Gas Light Company have declared the usual quarterly dividend of 2 per cent. It is payable since Thursday last.

THE Directors of the Hartford City (Conn.) Gas Light Company have declared the usual quarterly dividend of 2 per cent. The payment date was the 1st inst.

MR. H. F. BARROWS, JR., has been elected President of the North Attleboro (Mass.) Gas Light Company, vice his father, the late H. F. Barrows. Mr. Woodbury Melcher was elected to the vacant seat in the Directorate.

MR. ROBERT COLT, President of the New London (Conn.) Gas and Electric Company, died at his home in that city the evening of June 19th. Deceased, was born in New London, April 26th, 1830, and for half a century was prominent in the commercial, political, religious and social life of Eastern Connecticut.

A CORRESPONDENT in St. Louis, Mo., forwards the following: "The funeral of Mr. James A. Montgomery, who died from the effects of an operation for the removal of a stomach cancer the afternoon of June 13th, took place from his home, Delmar avenue, St. Louis, the morning of June 15th, the Rev. George W. King officiating. Interment was made in Bellefontaine cemetary. Mr. Montgomery was born in Springfield, Ky., December 18, 1846, and moved to Sedalia, Mo., with his parents when he was 11 years old. When he had grown to manhood he engaged in the gas business and for 27 years he was Manager of the Sedalia Gas Company. At the same time he built and managed gas plants at Moberly, Lexington, Nevada, Mo., and Greencastle, Ind. Two years ago his health broke down and he went to Dallas, Tex. He removed to St. Louis, where he became associated with with the Jennings-Amos Manufacturing Company as Treasurer. He was a member of the Masons, Knights of Pythias and the Royal Arcanum. He was elected to membership in the Western Gas Association at the meeting held in 1881."

ATWATER, Minn., is said to want a gas works in its midst. The place is too small.

MR. ALBERT F. KERSTING, formerly in the service of the Pittsfield (Mass.) Coal Gas Company, has been appointed Resident Manager of the Florence (Ala.) Gas Light and Fuel Company.

MR. ALBERT PABST, for some years in charge of the Youngstown (O.) Consolidated Gas and Electric Light Company, has resigned from the service of the Company. His successor is Mr. H. L. Patterson, formerly with Messrs. Sanderson & Porter, electrical consulting engineers of this city.

SOME time ago the City Gas Company of Norfolk, Va., offered four premiums for the best articles descriptive of the merits of cooking by gas, the contributions to be judged by a committee to whom the names of the composers were unknown, the articles being indexed or identifiable by a number. The competition was arranged by Mr. F. H. Sawyer, Assistant General Manager of the Company, and the prizes were as follows: First, a round trip ticket to the St. Louis Exposition; second, a standard gas range connected up; third, 5,000 cubic feet of gas; fourth, 3,000 cubic feet of gas. The articles that obtained the respective prizes and their authors were as follows:

First, by Mrs. A. L. Woodin:

I've tried the wood range, and the coal—
  I've tried the gasoline—
And, too, I've tried a patent stove,
  That burned plain kerosene.

The gasoline was dangerous,
  The wood was high and green;
The coal trust, too, was treacherous,
  Likewise the kerosene.

Now, I've your range, I've made the test;
  Beats gasoline, or oil,
Or wood, or coal, it is the best,
  Will bake, roast, toast, or broil.

It makes no ashes, soot or smoke,
  No odor to offend.
I freely say—this is no joke—
  Your range is my best friend.

It's more convenient, I will state,
  Than any other range,
And less expense to operate;
  For none would I exchange.

Second, by Mrs. L. W. Pigolt:

"Gentlemen—1. I have cooked on all kinds of stoves, all over the United States, ever since I was married (48 years ago), but your gas range infinitely excels them all. Less trouble to operate—exceedingly simple—a child can work it—no coal nor wood to tote in—no ashes to take out—no smoke—no soot—perfectly cleanly—always ready—when everything is prepared, light the gas—when everything is done extinguish the fire. This makes it the most economical.

"2. It is the most efficient—will bake, roast, toast, fry, broil, stew, boil—all at one time, and do anything else you want it to do better and quicker than any other.

"3. It is the most economical—costs me 75 cents per month, oftimes less.

"4. I have used it 4 years. Could I not get another, would not part with it for 10 times its cost."

Third, by Mrs. E. M. Blauvelt:

"Gentlemen—My enthusiasm over the gas range is to be explained by the fact of its having solved for me the most difficult problem of the modern housekeeper, the servant question.

"The coal range, with its increasing demand for attention, its ashes, smoke and refractary dampers, necessitated the services of a cook constantly.

"Since the installment of my gas range I do my own cooking and find it not only free from drudgery, but a positive pleasure. My meals are prepared in the length of time it formerly took to get my stove hot, and considering the fact that I save a cook's wages and board. I can honestly say that the gas range puts money in the bank for me every month."

Fourth, by Mrs. J. E. Lindsay:

"I have for some time used a gas range for making desserts, baking bread, etc., and if I couldn't get another, under no circumstances would I part with this. For the regularity of heat, which is obtained without the trouble of feeding the fire, it is unexcelled. To a woman without a servant (and she can never tell when she is going to be left without one) a gas range is the greatest blessing of the age, for she can do her cooking with 50 per cent. less labor than before the gas range made its debut, since there is no fire to kindle and keep up and no ashes to remove afterwards. From a woman's point of view it is the greatest invention of the nineteenth century. Long live the gas range."

SOME capitalists largely interested in real estate holdings in certain growing suburbs of Norfolk, Va., are arranging for the construction of a works for the supply of gas to the districts concerned. They have been impelled to this step by the unwillingness of the proprietors of the City Gas Works to extend their main system.

T. L. FISHER is informed that the Waukesha (Wis.) American Gas Company has been dissolved, and that its properties have been taken over by the owners of the Waukesha Gas and Electric Company.

THE owners of the Georgetown (D. C.) Gas Company have arranged for the piping of the Tenleytown district.

THE annual meeting of the Louisville (Ky.) Gas Company will be held to-day.

MESSRS. D. M. TAYLOR, J. E. Ramsey and Clem. McCormack have given notice that they will apply for a charter under which to operate a gas plant in Oxford, Pa. The applicants control the policy of the Oxford Electric Light Company.

THE Western Fuel, Gas and Power Company announces that it is now supplying gas for fuel and lighting purposes to the residents of Redondo and Hermosa, Cal.

THE Youghiogheny Gas Coal Company has been organized by Messrs. T. J. Axtell, C. E. Cartwright and Frank F. Tillotson. It is capitalized in $10,000, and its headquarters are in Detroit, Mich.

THE Kalamazoo (Mich.) Gas Company is now comfortably housed in its commodious office quarters on South Rose street.

THE British Columbia Electric Company, which supplies electric currents in Vancouver, New Westminster and Victoria, B. C., has secured control of the plant and trading of the Vancouver Gas Company.

THE City Council, of Paris, Ills., has granted a new franchise to the bondholders who recently purchased at auction the properties and rights of the Paris Gas Light and Coke Company. The franchise is to run for 30 years, and the Company may not sell gas at a rate to exceed $1.50 per 1,000 cubic feet.

THE Orange County Gas and Electric Company, of Middletown, N.Y., has been placed in the hands of a receiver on the decree of Judge Blanchard of the Supreme Court. The receiver is Mr. George A. Swayze, of Middletown.

MESSRS. HENRY T. DUKE, M. T. Butler and J. S. Freeman, have given notice of their intention to apply for papers incorporating the East Penn Gas Company, which proposes to supply gas to the residents of Quakertown, Perkasie, Sellersville, Langhorne, Yardley, Morrisville, Newtown, New Hope, Rockhill and Telford, all boroughs of Bucks County, Pa.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

MONDAY, JULY 4 1904.

The Market for Gas Securities.

There was little animation in the trading in local gas shares during the week, and the net result of the business done was a decline of close to 3 points in Consolidated, which closed to-day (Friday) at 192¼ to 193. The Company has applied to the courts for the relief sought under what was known as the Remsen bill, and there is very little doubt that the permission will be granted. The output on fuel account so far this season has been in the nature of a record breaker. Mutual is again being inquired after, but no stock is offered.

Brooklyn Union is dull, at 210 to 220, which seems a very low estimate of the worth of a huge metropolitan company, the business of which is on a 10 per cent. dividend basis. Peoples, of Chicago, is dull and strong, and Baltimore Consolidated is 72½ to 73. A sharp slump in Laclede preferred was the feature of the week, the closing figures for which were 69 to 70. Washington (D. C.) gas seems to be getting ready for another of its phenomenal moves, 287 being freely bid for it, holders asking 290.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

July 4.

☞All communications will receive particular attention.

☞The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$75,177,000	100	192¾	193
Central Union, Bonds, 5's	2,000,000	1,000	106¼	106½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	655,000	..	108	112
Mutual	3,500,000	100	270	300
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	105¼	106
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	34	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's	1,250,000	1,000	104¼	106½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109¼	111
" 1st Con. 5's	1,500,000	..	106	108
Standard	5,000,000	100	125	13
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	210	220
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	¾	3/16
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	3¾	4
" " Bonds, 5's	5,250,000	1,000	125	..
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	102½	102⅝
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	107½	109
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	72½	73
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	980,000	1,000	86	90
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99¼	100
Detroit Gas Co., 5's	981,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	85	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	255
Hudson County Gas Co., of New Jersey	10,500,000	..	67	68
" Bonds, 5's	10,500,000	..	103½	104½
Indianapolis	2,000,000	..	60	70
" Bonds, 6's	2,650,000	..	103½	106½
Jackson Gas Co.	250,000	50	73	75
" 1st Mtg. 5's	200,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	..
Preferred	2,500,000	100	69	70
Bonds	10,000,000	1,000	109¼	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	138	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218½
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	58	58
Bonds, 6's	4,000,000	..	105	105½
New Haven	1,000,000	25	64	70
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	97¾	98¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	92	94½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	118	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	94
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047,000	1,000	94	96
Washington, D. C	2,600,000	20	286¼	288¾
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	.	..	..
Wilmington, Del.	600,000	50	220	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., June 8, 1904.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable July 15th, 1904, to stockholders of record at the close of business, June 30, 1904. Checks will be mailed.

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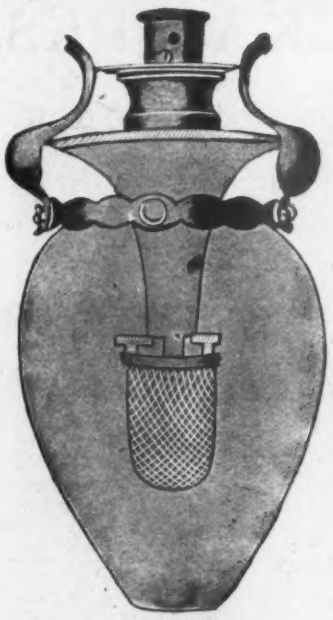

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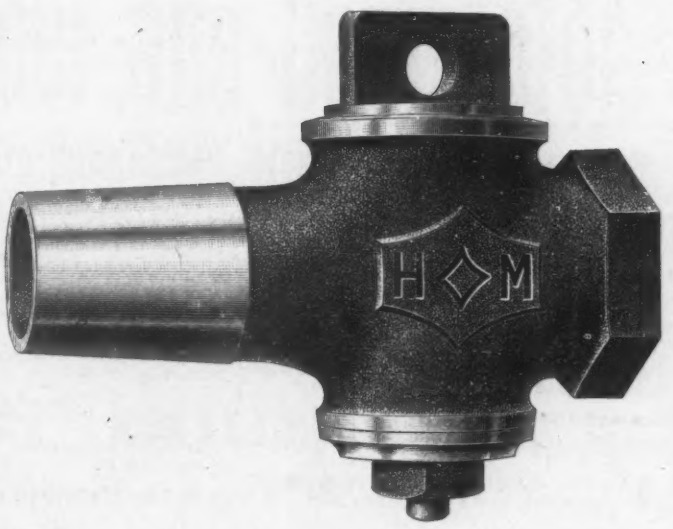

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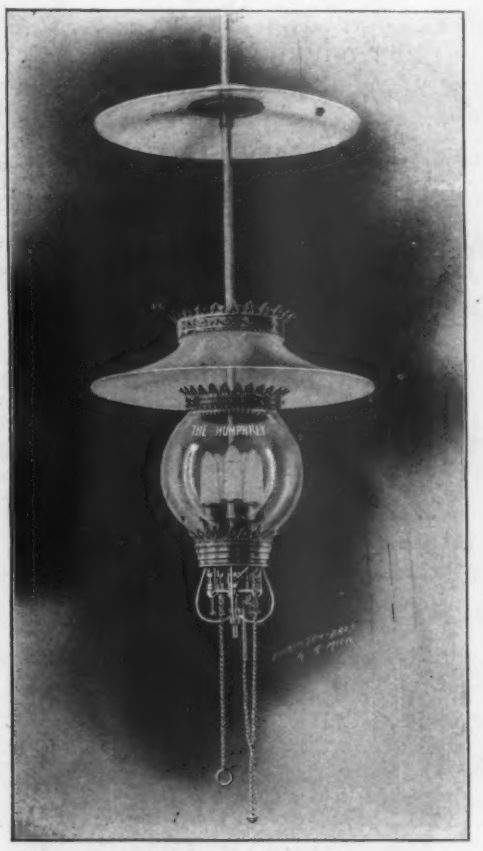

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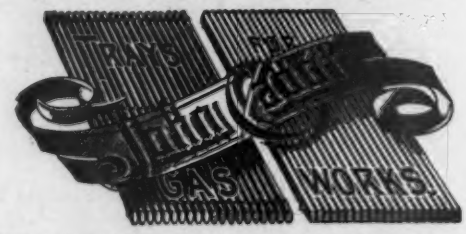

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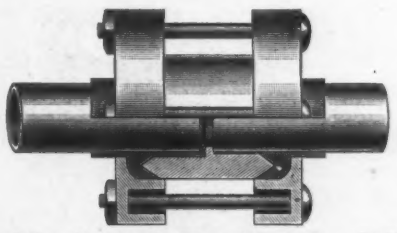

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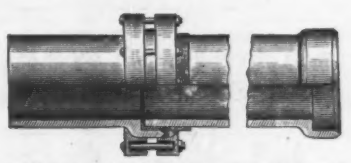

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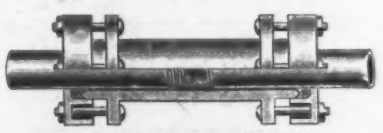

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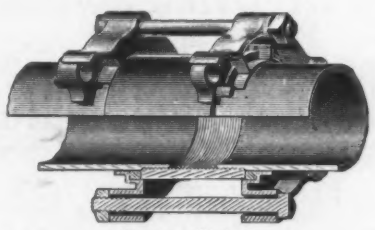

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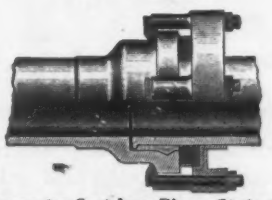

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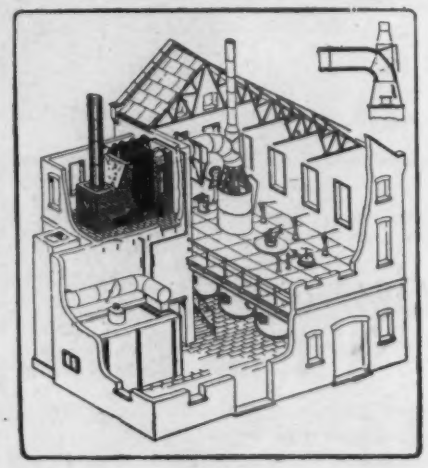

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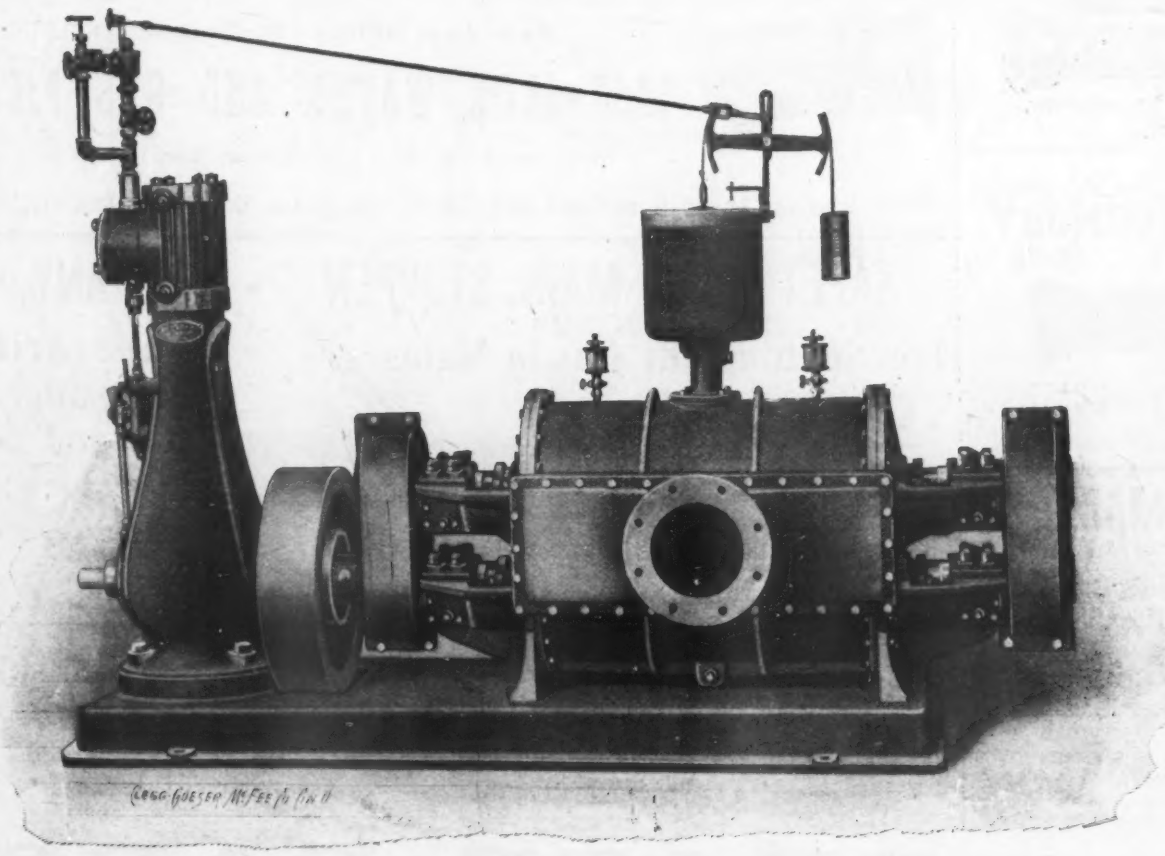

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Where d = diameter of pipe in inches,
p_1 = absolute initial pressure in pounds per square inch,
p_2 = absolute terminal pressure in pounds per square inch,
L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;
(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;
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(4.) Opposite any desired discharge will also be found the required diameter of pipe.

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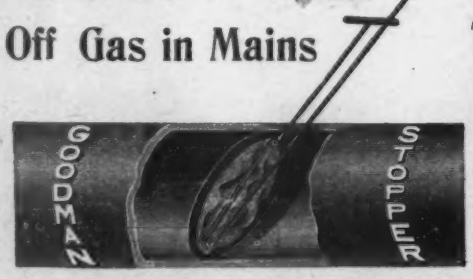

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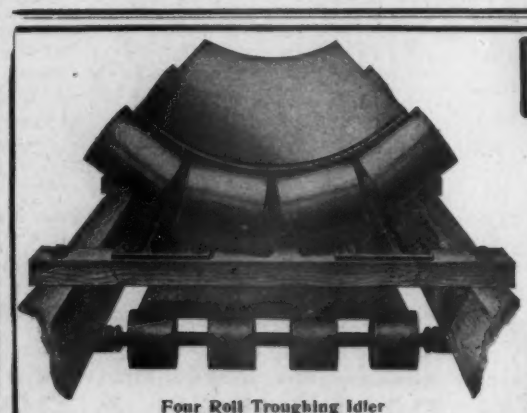

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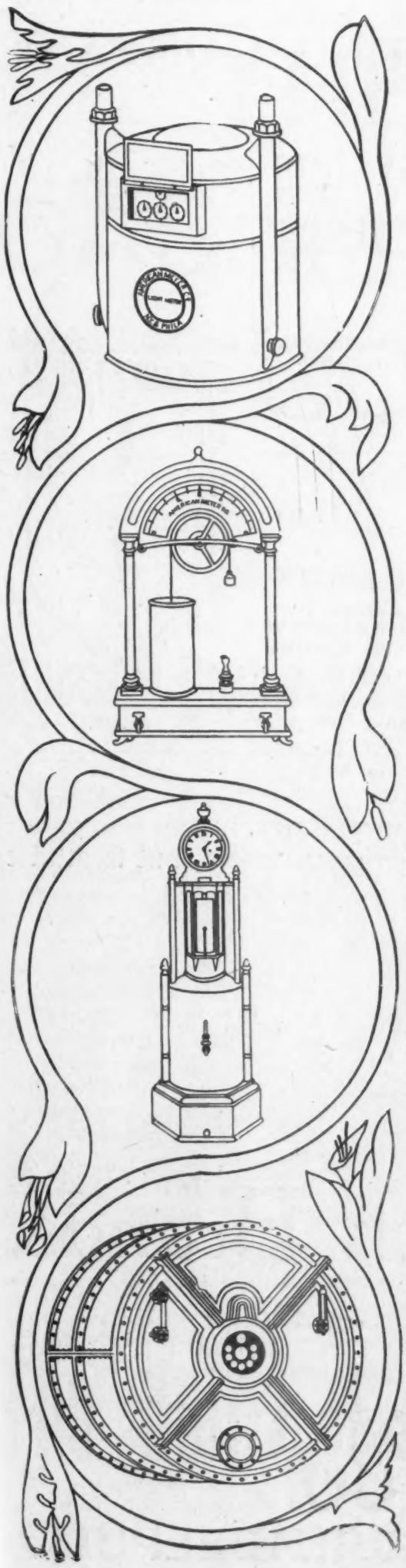

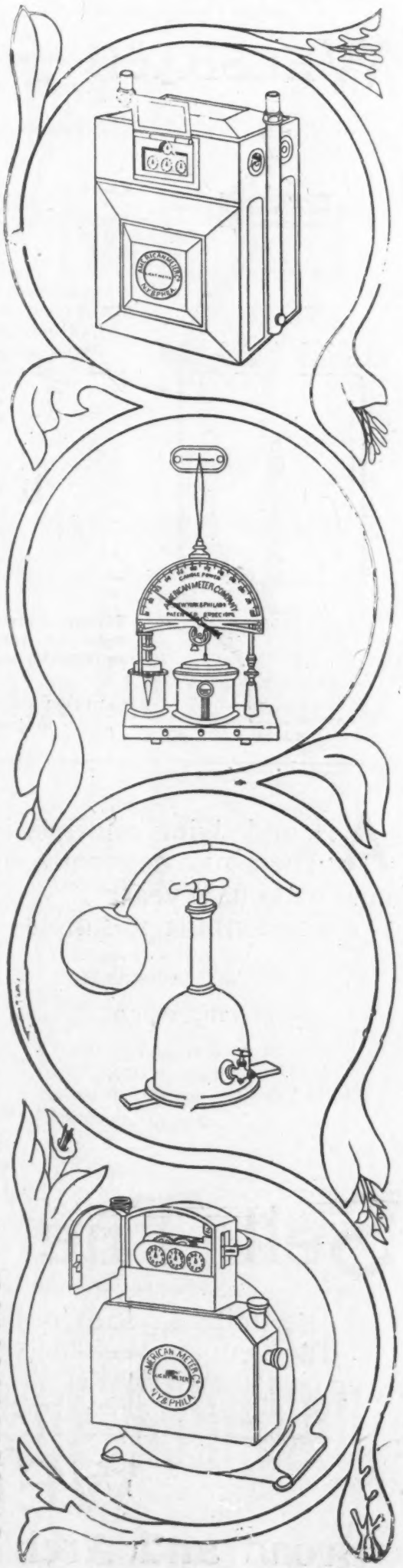

PUBLIC LIGHTING TABLE.

JULY, 1904.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	8.00 PM	10.50 PM	7.30	3.15
Sat.	2	8.00	11.20	7.30	3.15
Sun.	3	8.00	11.50	7.30	3.15
Mon.	4	8.00	12.20 AM	7.30	3.15
Tue.	5	8.00 LQ	12.50	7.30	3.15
Wed.	6	8.00	1.20	7.30	3.15
Thu.	7	8.00	2.00	7.30	3.15
Fri.	8	8.00	2.40	7.30	3.15
Sat.	9	8.00	3.40	7.30	3.15
Sun.	10	8.00	3.40	7.30	3.15
Mon.	11	8.00	3.40	7.30	3.15
Tue.	12	8.00 NM	3.40	7.30	3.15
Wed.	13	8.00	3.40	7.30	3.15
Thu.	14	8.00	3.40	7.30	3.15
Fri.	15	8.00	3.40	7.30	3.15
Sat.	16	8.00	3.40	7.20	3.15
Sun	17	9.30	3.50	7.20	3.15
Mon.	18	10.00	3.50	7.20	3.15
Tue.	19	10.40 FQ	3.50	7.20	3.15
Wed.	20	11.20	3.50	7.20	3.15
Thu.	21	12.00	3.50	7.20	3.15
Fri.	22	12.40 AM	3.50	7.20	3.15
Sat.	23	1.30	3.50	7.20	3.15
Sun.	24	2.20	3.50	7.20	3.15
Mon.	25	No L.	No L.	7.20	3.15
Tue.	26	No L. FM	No L.	7.20	3.15
Wed.	27	No L.	No L.	7.20	3.15
Thu.	28	7.50 PM	8.50 PM	7.20	3.15
Fri.	29	7.50	9.30	7.20	3.15
Sat.	30	7.50	10.00	7.10	3.30
Sun.	31	7.40	10.30	7.10	3.30

TOTAL HOURS LIGHTING DURING 1904.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	225.00	January	423.20
February	205.40	February	367.40
March	187.40	March	355.35
April	169.50	April	298.50
May	152.30	May	264.50
June	137.20	June	234.25
July	138.50	July	243.45
August	151.00	August	280.25
September	164.40	September	321.15
October	191.30	October	374.30
November	210.30	November	401.40
December	237.10	December	433.45
Total, yr.	2171.40	Total, yr.	4000.00

NEW YORK, 97 Liberty Street.
BOSTON, 814 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
CHICAGO, Foot of Orleans Street.
SAN FRANCISCO, 712 Polk Street.

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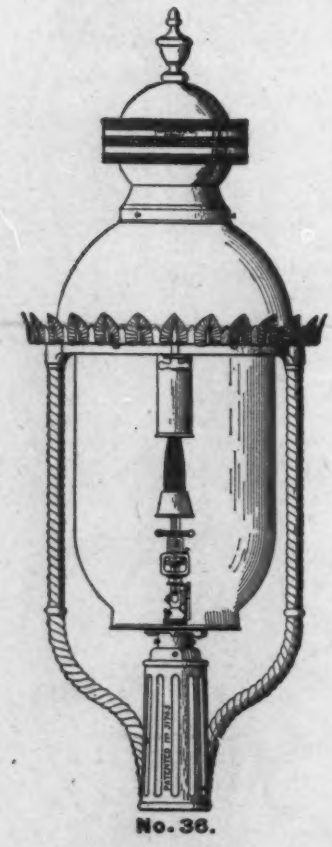
.... OF AMERICA ....



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Chicago, Ills.	Newark, N. J.	Cicero, Ills.
Amesbury, Mass.	Washington, D. C.	Chicago (Ogden Co.)
Aberdeen, S. D.	Boone, Ia.	Easton, Pa.
Winsted, Conn.	Pueblo, Col.	Lawrence, Mass.
Canon City, Col.	Charlotte, N. C.	Council Bluffs, Ia.
Schenectady, N. Y.	Fall River, Mass.	Chattanooga, Tenn.
Hagerstown, Md.	Duluth, Minn.	Tuckerton, N. J.
Malden, Mass.	New York (Mutual Co.)	Springfield, O.
Bridgeport, Conn.	Waltham, Mass.	Easton, Pa. (2d contract).
Albert Lea, Minn.	Dover, Del.	Mobile, Ala.
Brooklyn, N. Y.	York, Pa.	Conshohocken, Pa.
Kansas City, Kas.	Minneapolis, Minn.	Mason City, Ia.
Hempstead, N. Y.	Allentown, Pa.	

TOTAL SETS FOR 1903, ... 62
TOTAL DAILY CAPACITY, ... 62,950,000 cubic feet.
TOTAL SETS TO DATE, ... 508
TOTAL DAILY CAPACITY, ... 362,780,000 cubic feet.

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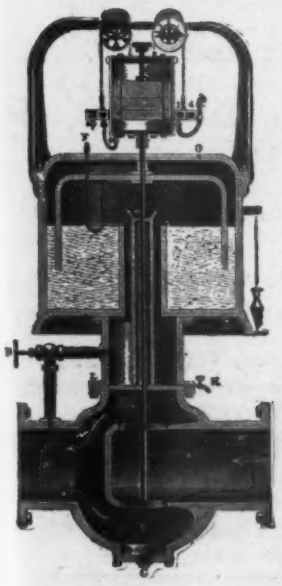

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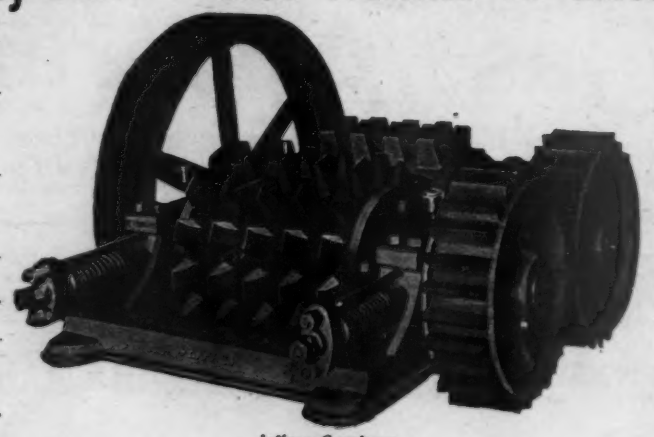

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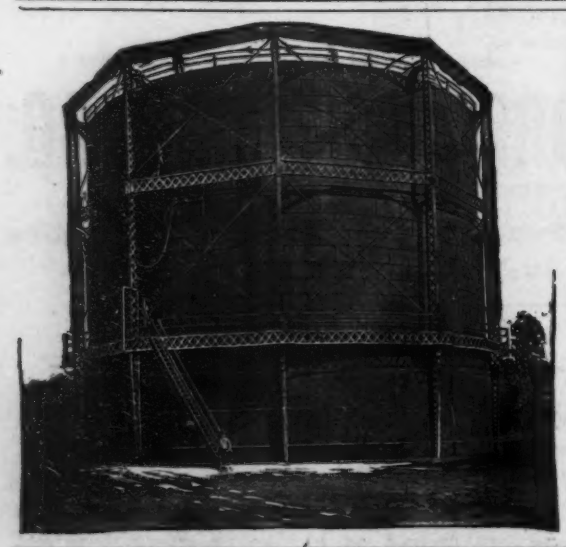

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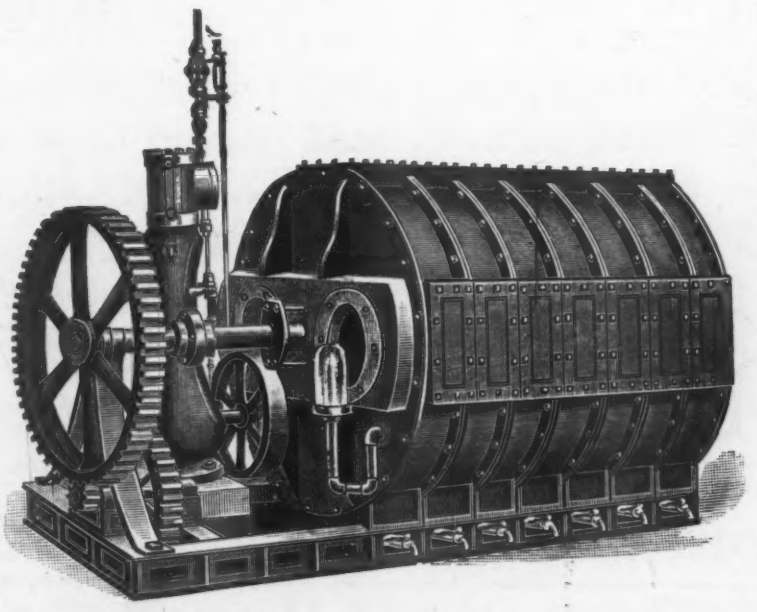

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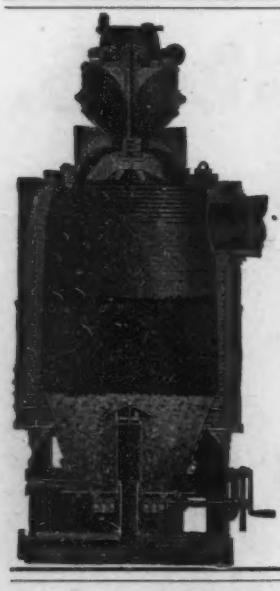

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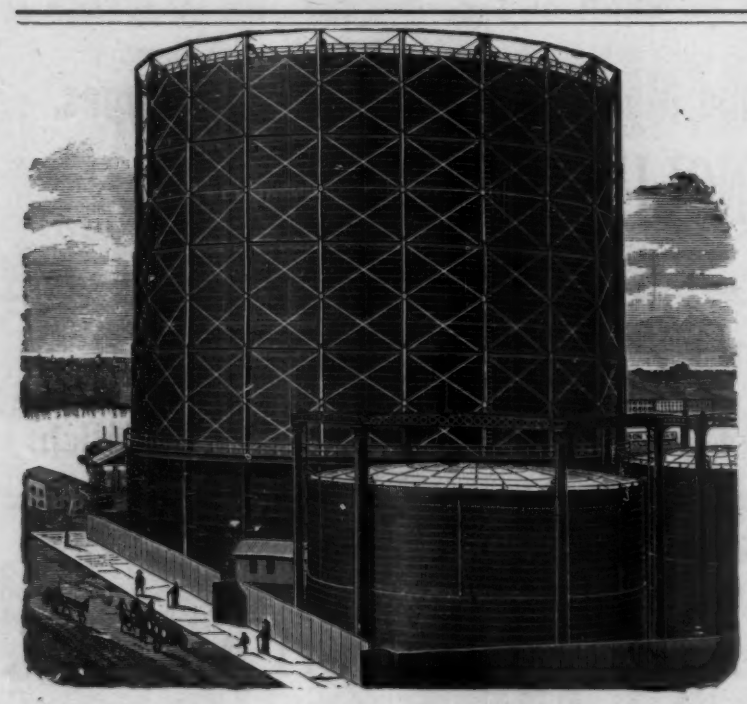

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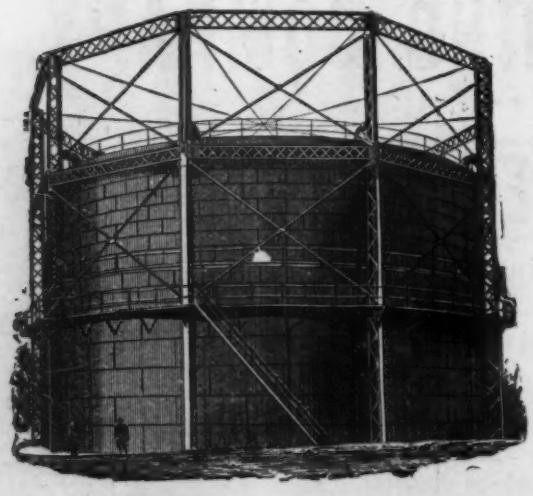

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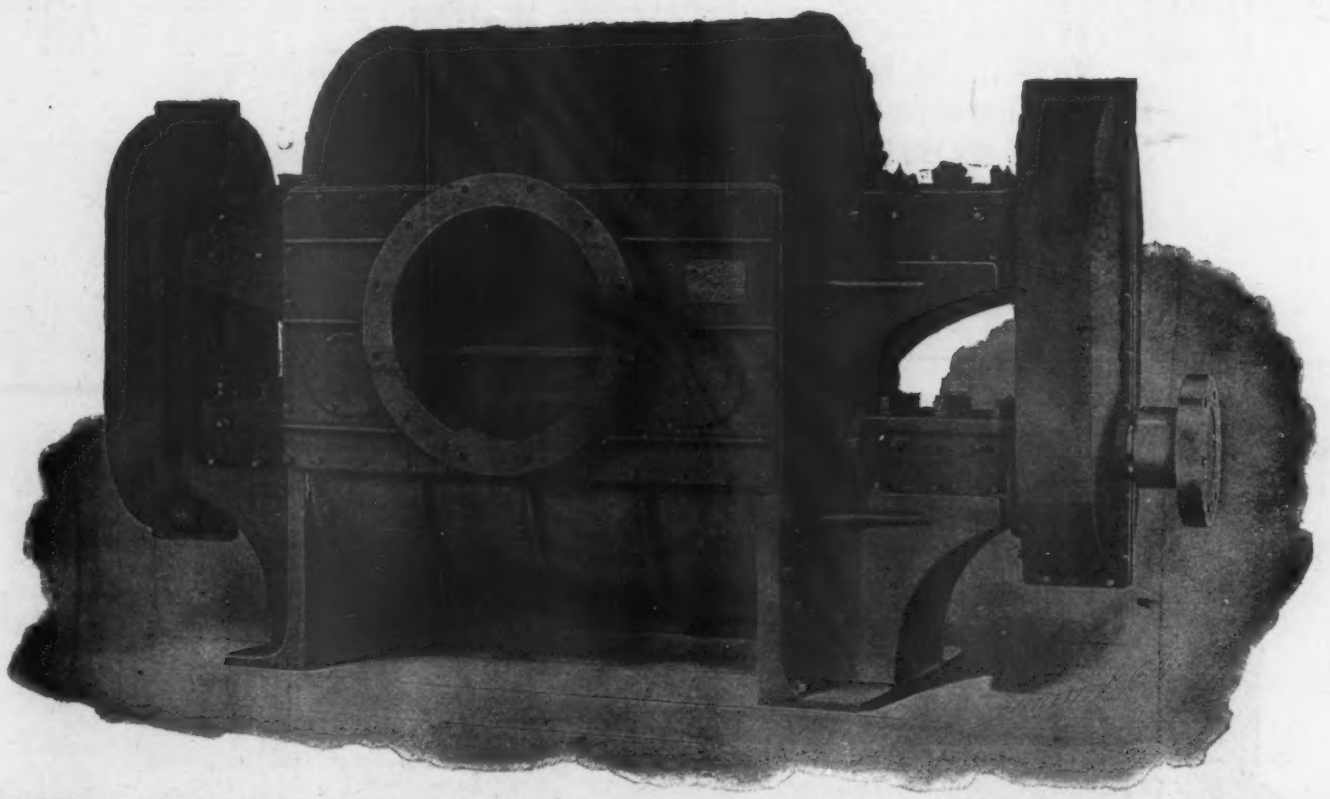

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